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THE GOBY DREDGE-TRAWL FISHERY OF LAGUNA DE BAY, WITH NOTES ON THE COMPOSITION OF THE COMMERCIAL CATCHES

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FIVE PLATES AND ELEVEN TEXT FIGURES

INTRODUCTION

The goby dredge-trawl fishery is comparatively a new industry, being developed during the postliberation period. At the close of 1950 it became an established industry along Rizal Province side of Laguna de Bay. This industry consists principally of the catching of white goby, *biyang puti* (*Glossogobius giurus*), with the use of an indigenous dredge-trawl gear operated on fishing dugouts. The gear was formerly employed in gathering fresh-water mollusks, which are the basic feed of the commercially raised ducks (*Anas boschas*) around the lake. Conservative estimate in 1950 placed the value of the industry in the neighborhood of 160,000 pesos worth of fishing craft, equipment and accessories. The extensive operation of this new fishing gear has resulted in various conflicts, if not in competition, with the other commercial fishing gear used in Laguna de Bay. As a consequence, two controversial views on the destructive effect of the gear have prevailed. One group claims it is a destructive gear to the demersal fishery; the other claims otherwise. In view of these

conflicting claims, some studies on the gear and its operation, as well as on the composition of the catches, were undertaken to determine its effects on the fishery resources.

Laguna de Bay (text fig. 1) is the largest fresh-water lake in the Philippines with an estimated area of about 930.7 square kilometers,[1] excluding Talim Island. It is a relatively shallow,

FIG. 1. Map of Laguna de Bay showing divisions of reference areas.

flat and muddy lake with a depth ranging from 3.5 meters in the middle area to 22 meters at a point near Diablo Pass. The average depth of the trawlable area (approximately 850 square kilometers) is about three meters. The nature of the bottom is generally of soft mud with sandy littoral areas near the mouths of inflowing rivers. The areas around the small island and headlands are generally rocky and muddy. These conditions of relative shallowness, muddy smooth bottom and almost perennial turbidity of the water make it ideal for the growth and multiplication of melanid snails and clams as well

[1] Aldaba, Vicente. The dalag fishery of Laguna de Bay. Phil. Jour. Sci. 45 (1931) 41–57.

as for the operation of dragnets, fish-corrals and gillnets in the lake throughout the year.

INTRODUCTION OF THE GOBY DREDGE-TRAWL AND OTHER TRAWLS IN LAGUNA DE BAY

The dredge trawl was evidently evolved from the age-old snail dredge trawl (*kaladkad*) commonly used in the commercial gathering of clams and snails used by the duck industry around Laguna de Bay. As far as it could be ascertained the fishermen of the municipalities of Pasig, Pateros, Taguig, and Binangonan, Rizal Province, were the originators of this goby dredge trawl.

As early as 1943 some experimental tests of the dredge trawl were conducted by Pasig and Pateros fishermen. But during the boom of the duck-raising industry in 1945–1947, the use of the dredge trawl ceased for sometime. However, immediately after the major collapse of the duck industry brought about by the typhoon "Jean" on December 26, 1948, the dredge trawl was revived by fishermen of Laguna de Bay as a means of livelihood. A much improved design, which was developed by the fishermen of Barrio Kalinawan, in the municipality of Binangonan, Rizal Province, came into use.

The original contrivance was a one- or two-dredge-trawl nets towed by a sailing fishing craft. Later in 1949–1950 motorized fishing crafts and motorlaunches towing three to four nets from a fishing craft were used. This motorlaunch-towed fishing craft was initiated by Pasig snail fishermen who fished alternately or wholly for snail and/or fish. With the collapse of the duck-raising industry in 1948–1949, a large number of the fishing craft formerly used in the snail fishery were converted into dredge trawlers purposely for *biya*, hence, the local name *"kaladkad pambiya"*.

In 1949 a commercial beam trawl gear (Japanese utase) operated on a 60-foot motorlaunch was tried with success in Laguna de Bay, but many fishermen in the lake objected to its use. It damaged a lot of set lines (*kitang*) and gill-nets (*pante*) besides offering stiff competition with other fishing gear. However, it ceased operation after a few months. A small experimental otter trawl was also used by the Bureau of Fisheries for the purpose of assaying the bottom resources of the lake. The operation of the beam and otter trawl was often beset by constant digging-in of the foot-rope on the very

soft bottom of the lake. To offset this difficulty, flat stone weights and footrope seized with old netting were used.

THE FISHERMEN

Two or three men form the fishermen crew of sailboats and motorized craft. Each fishing craft is generally owned by the "head" fisherman who usually acts both as the pilot and as master fisherman. The crew are usually paid on the share basis of the catch. After deducting the operating expenses, 25 per cent of the net return goes to the vessel and gear, and the remaining 75 per cent is equally divided among the crew. Since this group of fishing vessel is less than three tons gross, a licensed skipper or engineer is not required as in a motorlaunch-towed fishing craft.

In motorlaunch-towed fishing craft, 50 per cent of the net return goes to the towing motorlaunch, 25 per cent to the towed fishing craft and fishing equipment, and 25 per cent to the fishermen. However, if the towing motorlaunch and towed fishing craft are both owned by the same person, the fishermen are paid on the daily basis of from 3 pesos to 4 pesos each. The towed fishing craft is usually manned by three or four fishermen and the towing motorlaunch by two or three men, a licensed skipper and two deckhands.

THE FISHING CRAFT

On the basis of the nature and mode of propulsion, the fishing craft are classified into three categories, namely, sailboat, motorized and motorlaunch-towed craft. Table 1 shows

TABLE 1.—*Number and kind of dredge-trawler units operating in Laguna de Bay (as of August, 1950).*

Kind	Number
Sailboat craft	184
Motorized craft	12
Motorlaunch-towed craft	4
TOTAL	200

that of the 200 operating units reported in August, 1950, 184 were sailboats, 12 motorized and four motorlaunch-towed fishing craft. Motor power used ranged from single, double to four cylinder gasoline engine (8 to 15 horsepower, air- or water-cooled types) which are installed on large dugout craft.

The fishing craft proper consists of the conventional wooden dugout which varies in size and mode of rigging for the dif-

ferent categories. The dugout is shaped out of a log of *mayapis, Shorea palosapis* (Blanco) Merr., and side plankings of *palosapis, Anisoptera thurifera* (Blanco) Merr., are added to increase the free board of the fishing craft.

Sailboat fishing craft (*Plate 1, fig. 1; text fig. 2*).—A typical sailboat fishing craft consists of a dugout measuring from 10 to 12 meters long, 1.0 to 1.3 meters wide and about a meter deep. It is propelled by a pair of lateen sails consisting of a main and a foresail. It has an open deck like the other two types of fishing crafts. The deck flooring consists of preformed bamboo or wooden slats which are made into removable sections.

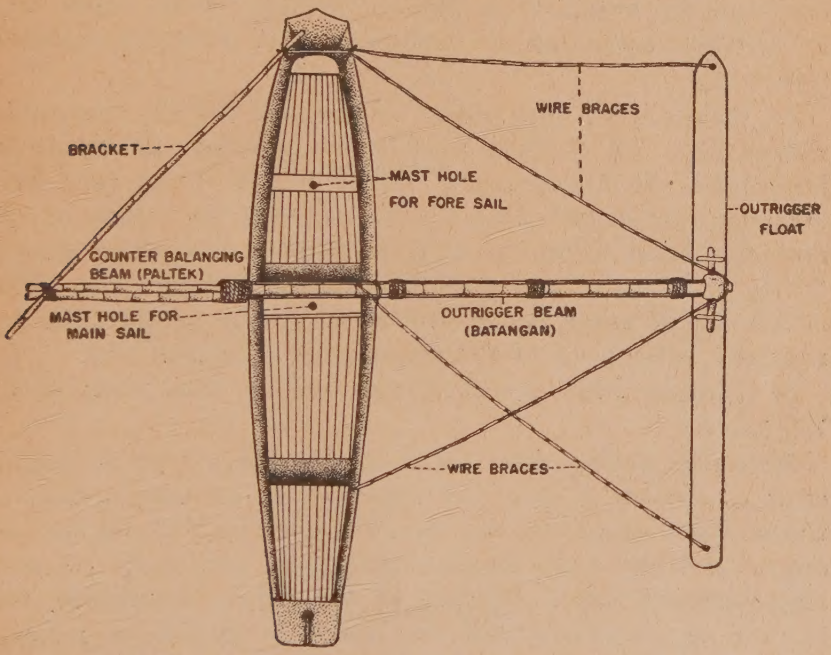


FIG. 2. Deck plan of a typical sailboat fishing craft towing one to two dredge-trawl nets (diagrammatic).

The craft is provided with a single outrigger fixed on the starboard side of the fishing craft. The outrigger consists of a six-meter bamboo (*Bambusa spinosa*) beam (*batangan*) and a wooden float (*palañgoy*). To strengthen it, the beam is braced by a pair of boards (2″ × 6″ × 20′) which are

bolted through the main bamboo beam and seized together by a series of galvanized iron wires or Manila rope seizings. Toward the portside, the beam is extended by a pair of short bamboo beam for counterbalancing purposes (*paltek*). This is supported from the forward bow by a bamboo bracket and mast stays.

The outrigger float is made of a flattened elongate box (6″ × 12″ × 20′) although a number of fishing craft still use the original paired bamboo floats. This box float is completely hollow inside and is constructed from 2-inch tanguile boards. It is thoroughly coated with coal tar to preserve and to keep it watertight. The outrigger float is held in place to the beam by means of a wooden outrigger beam collar and by forward, cross and aft braces made of jointed galvanized iron wire.

At the stern an open socket is provided for the removable rudder tiller. A portable open stove (kerosene or wood) is located aft the fishing craft. Three or four holes (one inch diameter) are drilled along the midcenter of the bottom of the dugout in order to provide entrance of fresh lake water during fishing and for drainage when beaching the fishing craft. The circulation of water in the livewell is crudely provided for by regularly bailing out of the water with a 2-gallon pail.

A complete outfit including two sets of nets costs about 750 pesos.

Motorized fishing craft (*text fig. 3*).—This type of fishing craft is similar in size and general plan of construction to the sailboat, except that the former is provided with an inboard engine and two equal bamboo outriggers and floats on port and starboard sides. Because of the engine installation, the livewell is eliminated and the catch is stored in bamboo baskets. To keep them in fresh condition while in the fishing ground, the fish are stored in alternate layers of either rice straw or banana leaves. Since this type of craft usually operates in the evening, the catches are iced at the landing before shipping them to markets early in the morning.

The engine is installed amidship and is provided with an engine coaming as a protection from the weather. The tiller of the rudder is controlled by an extension lever arm to a wheel immediately behind the engine coaming. To protect the

engine against the rain or splash of lake water, the coaming is covered by either canvas or flat galvanized iron sheet.

A complete outfit including two sets of nets costs about 850 pesos.

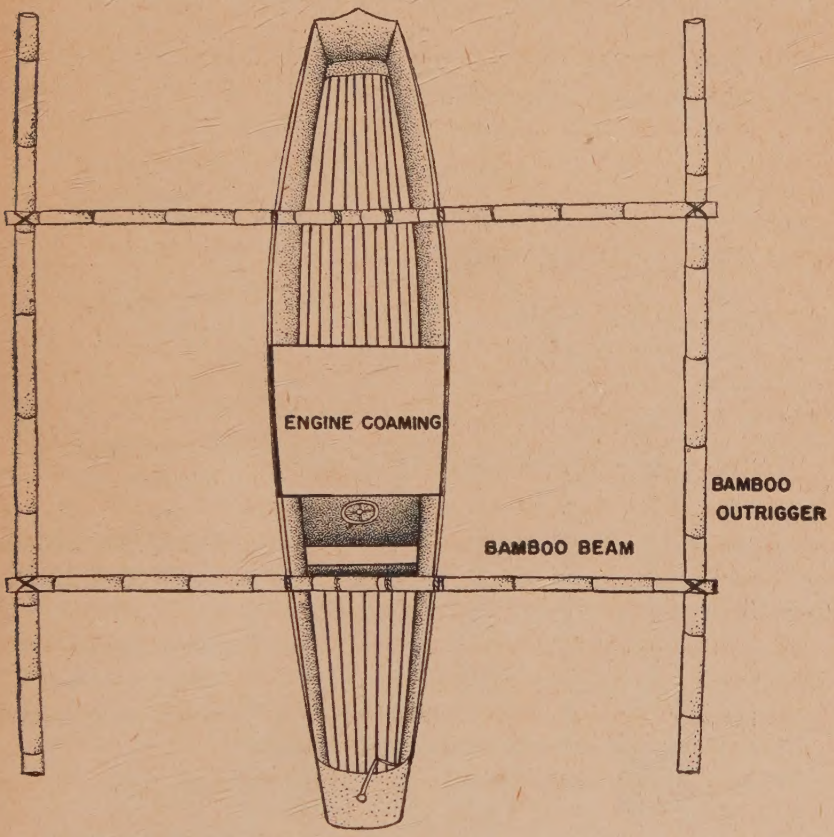


FIG. 3. Deck plan of a motorized fishing craft towing one or two dredge-trawl nets (diagrammatic).

Motorlaunch-towed fishing craft (*text fig. 4*).—The fishing outfit consists of a towing "mother motorlaunch" of about 8 to 15 tons gross, powered with a single diesel engine (70 to 225 horsepower) and one or two towed fishing craft. Ordinarily, one fishing craft towed operates four dredge-trawl nets. The "mother" craft is usually a 30- to 45-foot wooden harbor motorlaunch with a relatively shallow draft of about six feet.

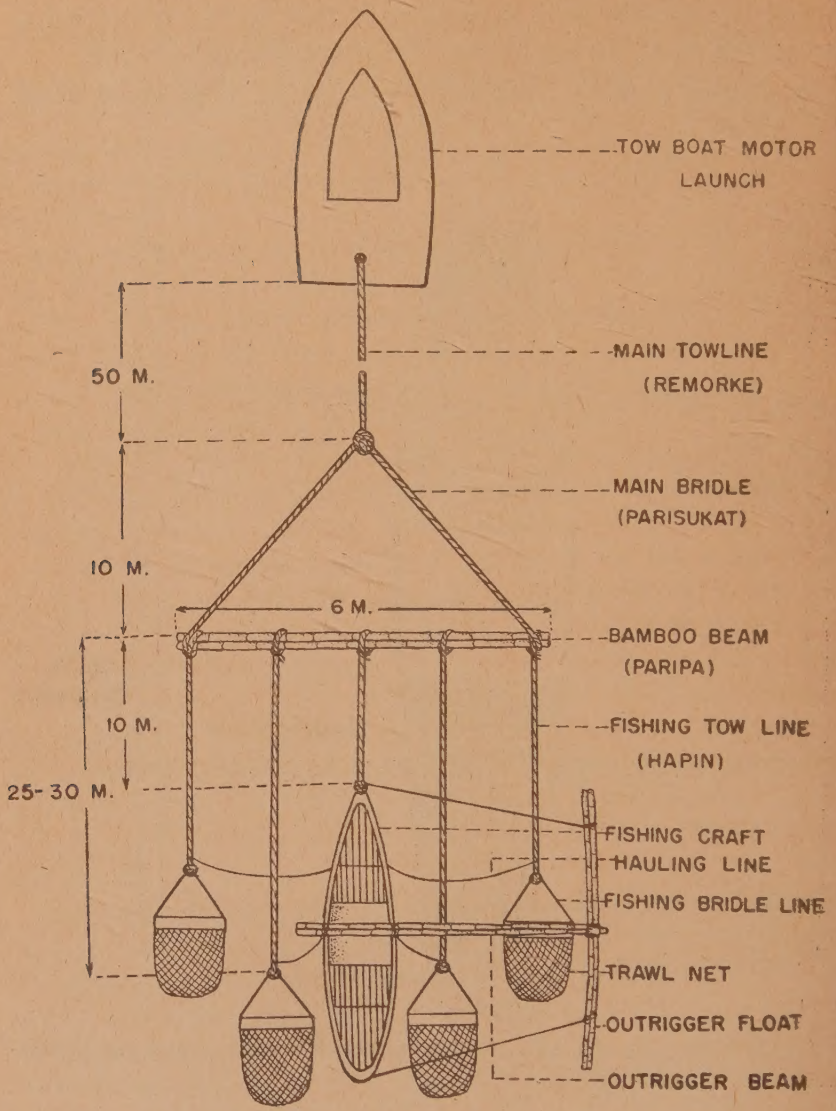


FIG. 4. Motorlaunched-towed fishing craft in operation using four nets (diagrammatic).

The fishing craft proper used is generally bigger than the two types just described. It is about 15 meters long, 1.5 meters wide and about a meter deep. This type of craft has a spacious livewell. It is provided with a starboard outrigger of paired beam and bamboo float. The deck is open with bamboo slat floorings. The midsection of the deck which is

open fore and aft at the bases of the outrigger beam serves as the hatch to the livewell. This uncovered portion of the deck also serves for the bailing out of water while the bottom intake holes of the vessel are open to provide aeration of the livewell. A rudder and an open hand tiller at the stern are also provided for the proper maneuvering of the craft during fishing operation.

A complete outfit including the mother motorlaunch costs from 5,000 pesos to 8,000 pesos,[2] depending upon the tonnage and power of the mother towing vessel.

THE FISHING GEAR

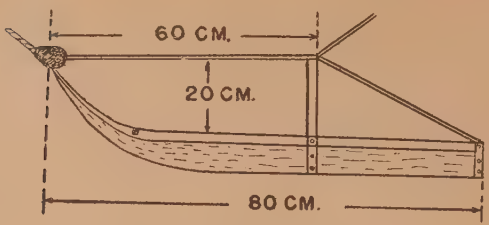
The dredge-trawl fishing gear consists of three main parts, namely, the towline (*remorke*), the dredge-trawl frame (*kaladkad*) and the net proper (*lambat*).

The towlines.—In sailboat and motorized fishing craft, a single towline (*hapin*) is attached to each individual net. It is of Manila rope, ½ to ⅝ inch diameter and about 30 meters long. A two-meter briddle of the same rope connects the towline to the dredge-trawl frame.

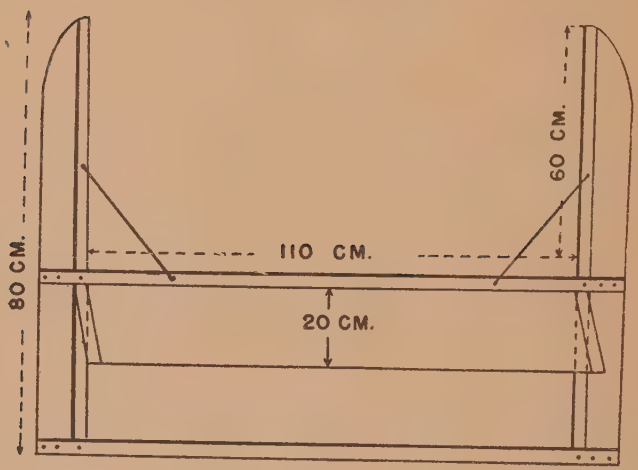
In motorlaunch-towed fishing craft, however, the towline consists of one main line (*remorke*) rigged to the towing motorlaunch and a series of individual fishing towlines (*hapin*) connected to each trawl net. The main towline is made of Manila rope, about 50 meters long and from 1 to 1.5 inches in diameter. This is connected to a 20-meter bridle (*parisukat*) of the same size. The bridle ends are secured to a bamboo beam (*paripa*), consisting of three pieces of a whole bamboo (6 meters long) seized together by G.I. wires or rattan splits. To this beam is secured the fishing craft at the center and the four towlines, each measuring from 25 to 30 meters long and ½ to ⅝ inch in diameter, which are evenly set on the beam. At the junction of each fishing towline and the fishing bridle line, a retrieving line 5 meters long, ½ inch diameter, Manila rope is connected for hauling-in the trawl net.

The dredge-trawl frame (*Plate 4, fig. 1, and text fig. 5*).—In effect the dredge-trawl frame serves as the basic skeletal structure of the gear, like the shrimp pipe trawl, the trawl-heads and sleds of the early original beam trawls used in the early days of trawling in New England and British Columbia (Symonds, 1947). The frame consists of a sledlike device

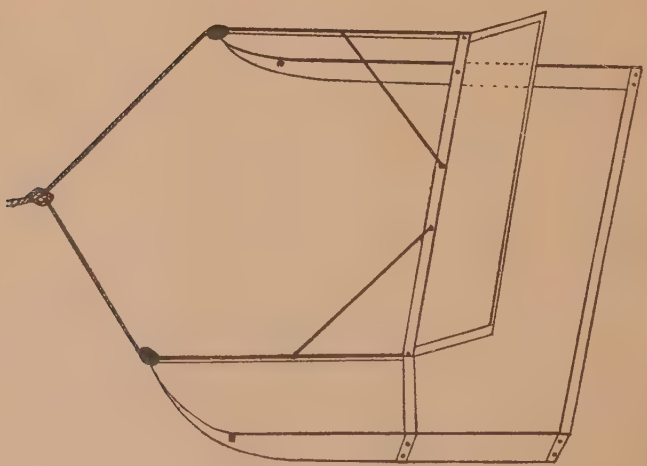
[2] One peso is equivalent to 50 cents U. S. currency.



(A)



(B)



(C)

FIG. 5. Dredge-trawl frame: (A) side view, (B) top view, (C) dorso-lateral view.

made from rivetted iron plates (¼″ by 1″) with two bottom skis or runners. These skis are made either of wood or G.I. iron sheets which prevent the digging-in of the gear on soft mud during operation. To keep the gear from hugging the bottom a horizontal paravane (rectangular wooden board, 20 by 110 centimeters) is rigged in an inclined plane (30° to 45°) on the top of the iron framework. The angle is adjusted by bending upward or downward the iron plate base of the wooden board.

The frontal opening of an average dredge-trawl frame measures 110 centimeters wide and about 20 centimeters in height (text fig. 5*b*). The horizontal length is about 80 centimeters from the tip of the sled-runner to its base. To strengthen the framework two diagonal iron braces, ⅜″ diameter, hold the upper framework. The fore-ends of the skis are connected by a fishing bridle, about 2 meters long, ⅝ inch diameter Manila rope (text fig. 5*c*).

The net proper.—Essentially, the net is similar in general features to that used for the snail dredge. The difference lies only in the size and mesh of the net used—the former being much bigger in size, with larger meshes and heavier netting. The dredge-trawl net and frame when wet weighs about ten kilos, convenient enough for two men to haul-in from the water with the fish catch.

A typical net measures from two to three meters long and about one meter in diameter at the mouth. Normally, a flapper is provided to prevent the escape especially of mudfish (*Ophicephalus striatus*) through the mouth of the net. It is made of a 25-centimeter strip of light netting sewed around the inside lining of the throat and nape of the net, about 30 centimeters from the mouth. The net is made of three parts, namely, the wings (*pakpak*), body (*katawan*) and the cod-end (*supot* or *pusod*).

In effect the wings are not actually a part of the main net. They consist of a barricade of netting rigged on the side of the frame of the skis. This is made of a piece of 6-thread cotton netting, 3-centimeter stretch mesh, which is held by a G.I. iron wire fitted to the shape and size of the side of the trawl frame where it is fixed permanently. As in the modern trawl, these wings prevent the escape of the fish toward the sides; thus increasing the efficiency of the gear.

Text fig. 6*a* shows the diagram of a dredge-trawl net. The net is entirely made of a 3-centimeter stretch mesh, No. 6 thread, seine netting. It is cut from a single piece of netting, 190 meshes long by 150 meshes wide. The shaded sections as indicated in the diagram are cut out. Then the bottom is folded over the top and the following sections are joined together: Sections A to B; E to C–C′; and E′ to D–D′. In folding, the top side is extended 10 meshes beyond the mouth (upper flap) which serves as the square as in the regular trawl nets. The final form of the net when assembled is shown in text fig. 6*b*, resembling a rectangular box. The bottom of the boxlike net becomes the cod-end. The rim of the mouth of the net is provided with a 2″-mesh selvage made of No. 9 thread, and of the same size of mesh as the body of the net.

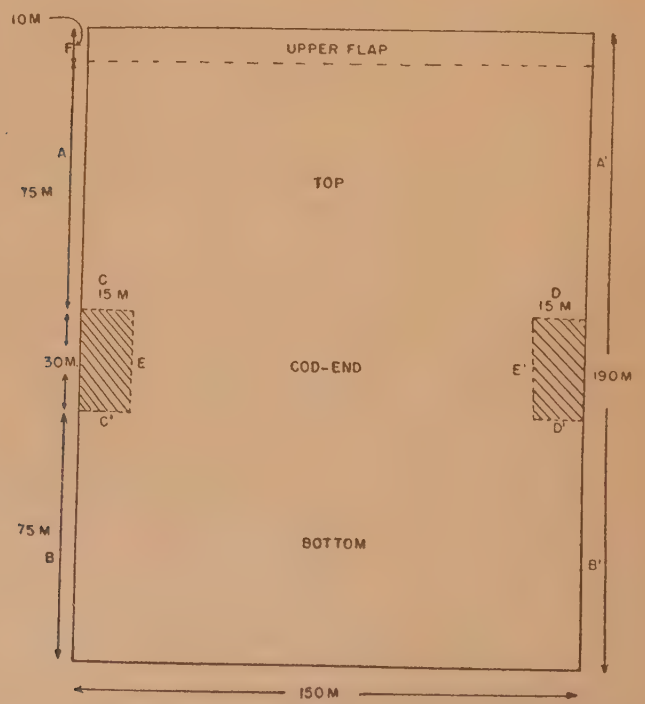


FIG. 6*a*. Cutting diagram of a piece of netting 3-centimeter stretched-measure mesh No. 6 cotton twine 150 x 190 meshes for making a typical fish dredge-trawl net.

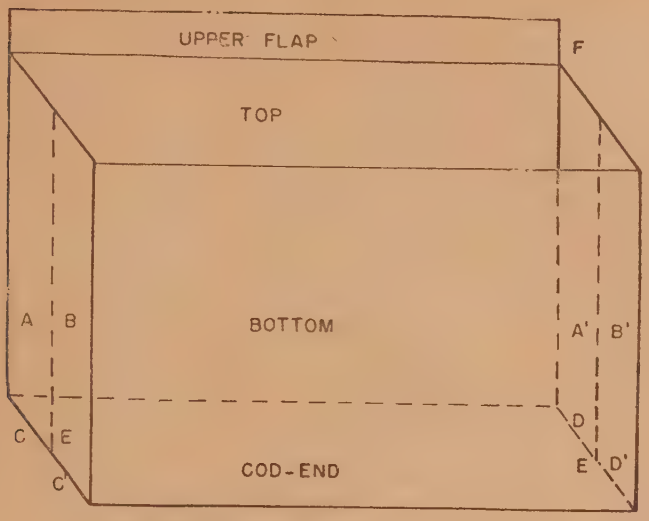


FIG. 6b. The dredge-trawl net after joining sections.

The actual cost of materials and labor needed for the construction of a dredge-trawl gear is as follows:

Frame	₱10.00
Net	10.00
Tow rope	6.00
Total	₱26.00

These dredge trawls are generally made by the fishermen themselves in small village shops located in Bangbang, Pasig and Kalinawan (Plate 3, fig. 1) Binangonan, Rizal Province, and in Gulod, Cabuyao, Laguna Province.

FISHING OPERATIONS

The dredge-trawl net, being light and handy, is suitable for use on board dugout fishing craft without the aid of mechanical deck equipment. The size of trawl nets used is almost the same for the three classes of fishing craft employed in the fishery in Laguna de Bay.

Sailboat fishing craft depend upon steady and moderate winds, which usually occur in the afternoons during the southwest monsoon period (June through August). However, during the northeast and easterly monsoon period (September through March) these winds are more or less steady from sunrise to sunset allowing a full-day fishing operation by the sailboat fishing craft.

The motorized fishing craft usually operate in the evening during the northeast monsoon period returning to port early in the morning to dispose off the catch still in fresh condition, thereby avoiding the use of a livewell.

The motorlaunch-towed fishing craft operate throughout the year except during heavy winds or typhoons. Normally, they leave port between 5:00 and 6:00 o'clock in the morning, arriving between 8:00 and 9:00 in the fishing ground. However, those in the homeport, in Pasig, Rizal, usually leave between 2:00 and 3:00 in the morning, arriving in the fishing ground between 5:00 and 6:00 of the same day. They leave the fishing ground between 12:00 and 1:00 o'clock in the afternoon, arriving Pasig at about 3:00 o'clock, in time for the fresh-fish market. Motorlaunch-towed fishing craft usually clear off the fishing ground before 4:00 in the afternoon in order to allow gill net and set line operators to set out their gear. These gears are retrieved at sunrise of the following day before the dredge trawlers start to operate again.

Shooting the net.—In the fishing ground, after securing all the towlines of each individual net and setting the proper course and trawling speed of the fishing craft, the nets are payed out one after the other on the starboard or port-side, depending upon the position of the towline on the securing beam. Each gear is shot overboard with both hands holding the frame and allowing it to hit flat on the water with the mouth of the frame downward. The towline is held taut until the net stretches out in the water and then the entire towline is released. Dragging then commences (Plate 2, figs. 1–3).

Hauling-in.—In sailboat and motor-propelled fishing craft, the craft is hove-to before the hauling-in operation. The sails are slacked off and/or the engines stopped. Then, the towlines are hauled-in by hands. The dredge-trawl frame is lifted out of the water and placed on deck. The cod-end part of the net is "shaked off" in the water to wash out the mud (Plate 5, fig. 1). The catch is then emptied on the bamboo deck (Plate 5, fig. 2), sorted and released while still alive into the livewell. The small-sized biya and kandule are thrown back into the sea. In motor-launch-towed fishing craft, however, the fishing operation involves a continuous process of alternate shooting and hauling of the four nets. The fishing craft is not hove-to or stopped except in case of a snag or fouling of the gear. However, the hauling-in of the nets is

done by one or two men alternately pulling the towline. A retrieving line, attached to each net facilitates the hauling of the nets on the side of the fishing craft (text fig. 4).

Frequency, speed and duration of drag.—In sailboat and motor-propelled fishing craft, a normal drag takes from 10 to 15 minutes depending upon the abundance of fish and nature of the sea bottom so that in an eight-hour fishing day from 20 to 30 hauls can be made. In motorlaunch-towed fishing craft however, about five to ten minutes is the duration per normal drag, thereby allowing from 70 to 90 hauls in one day. Evidently, more hauls can be made on motorlaunch-towed fishing craft because of its continuous dragging operation. The speed of dragging ranges from one to two miles per hour, the latter rate having been observed in the motorlaunch-towed fishing craft.

Trawl-warp depth ratio.—The trawl-warp depth ratio varies from 6 to 8 times the depth in sailboat and motor-propelled fishing craft. In motorlaunch-towed fishing craft, the ratio is from 8 to 10 times the depth, the payed out towing line ranging from 25 to 35 meters long.

Species caught.—Table 2 shows the list of common marketable species caught by dredge trawlers in Laguna de Bay from June through September, 1950. Among the species of fish

TABLE 2.—*List of common marketable and nonmarketable species taken by dredge trawler in Laguna de Bay (June to September, 1950).*

English name	Tagalog name	Scientific name
Marketable species:		
White goby	Biyang puti	*Glossogobius giurus.*
Sea catfishes	Kandule	*Arius* spp.
Fresh-water theraponid	Ayuñgin	*Therapon plumbeus.*
Murrel	Dalag	*Ophicepalus striatus.*
Fresh-water catfish	Hito	*Clarias batrachus.*
Mullet	Talilong	*Mugil* spp.
Nonmarketable species:		
Prawns	Hipon	*Palaemon lanceifrons.*
Viviparid snail	Papan	*Vivipara angularis.*
Ampularid snail	Kohol	*Ampularia luzonica.*
Clam	Sulid	*Simpsonella subcrassa.*
Clam	Tulya	*Cyrena manillensis.*

caught were the white goby, *biyang puti* (*Glossogobius giurus*); sea catfish, *kandule* (*Arius* spp.); fresh-water theraponid, *ayuñgin* (*Therapon plumbeus*); murrel, *dalag* (*Ophicephalus striatus*); fresh-water catfish, *hito* (*Clarias batrachus*) and white mullets, *talilong* (*Mugil* spp.). Of the species taken, the white goby usually formed the major bulk of the hauls,

the amount varying in different months. From February through September about 65 to 98 per cent of the hauls consisted of biya; 0.5 to 35 per cent, kandule; and up to 14 per cent of dalag (Tables 3, 4 and 5). The theraponid (ayungin) very often formed the major bulk of the trash fish taken in

TABLE 3.—*Analysis by months of catches of sailboat fishing craft in Laguna de Bay towing two nets, Areas 2A, 2B, 4A, and 4B*

Date	Sailboat number	Fishing time	Marketable fish			Total catch	Rate of catch per hour
			Biya	Kandule	Dalag		
1950		*Hrs.*	*Kgs.*	*Kgs.*	*Kgs.*	*Kgs.*	*Kgs.*
July	1	6	19	9.0		28.0	4.6
	2	7	10	7.0		17.0	2.4
	3	6	12	8.0		20.0	3.6
	4	5	12	4.8		16.8	3.3
	5	5	17	12.0		29.0	5.8
	6	7	16	5.0		21.0	3.0
	7	5	24	15.0		39.0	7.8
	8	5	11	4.0		15.0	3.0
Total		46	121	64.8		185.8	
Per cent			65.1	34.9		100.0	
August							
2	9	5	16.0	1.5		17.5	3.5
	10	5	18.0	3.0	7	28.0	5.6
	11	5	20.0	3.0	23	46.0	9.2
	12	6	30.0	3.0		33.0	5.5
	13	5	16.5	4.0		20.5	4.1
	14	4	17.5	5.2		22.7	5.6
	15	3	14.2			14.2	4.7
	16	3	22.0			22.0	7.3
Total		36	154.2	19.7	30	203.9	
Per cent			75.6	9.7	14.7	100.0	

Average catch per hour in kilograms: July 4; August, 5.7.
All months combined: 4.8.

TABLE 4.—*Analysis by month of catches of motorized fishing craft using two nets in Laguna de Bay, Areas 2 and 4 (evening operation).*

Date	Fishing unit	Fishing time	Marketable fish		Total catch	Catch per hr. per unit
			Biya	Kandule		
1950		*Hrs.*	*Kgs.*	*Kgs.*	*Kgs.*	*Kgs.*
September:						
13	A	7	8	34	42	6.0
	B	7	6	16	22	3.0
	C	7	6	26	32	4.5
	D	7	7	28	35	5.0
	E	7	3	12	15	2.0
Total	5	35	30	116	146	
Per cent			20.6	79.4	100	

Average catch per hour in kilograms: September, 4.1.

TABLE 5.—*Analysis by months of catches of motorlaunch-towed fishing craft using four nets in Laguna de Bay, Areas 1A, 1B, 2A, and 2B.*[a]

Date	Fishing time	Marketable Catch			Total catch	Rate of catch per hr.
		Biya	Kandule	Ayuñgin		
1950	*Hours*	*Kgs.*	*Kgs.*	*Kgs.*	*Kgs.*	*Kgs.*
February						
2	7	99.0	2.5	----------	101.5	14.5
3	7	92.0	0.5	----------	92.5	13.2
5	7	93.5	----------	3	96.5	13.8
6	7	88.0	----------	----------	88.0	12.5
8	6	81.5	7.0	----------	88.5	14.8
9	7	102.0	5.5	----------	107.5	15.4
11	7	93.5	----------	28	121.5	17.4
13	7	81.0	4.5	----------	85.5	12.2
15	7	96.0	----------	18	114.0	16.3
16	7	95.5	12.0	----------	107.5	15.4
17	7	93.0	----------	----------	93.0	13.3
Total	76	1,015.0	32.0	49	1,096.0	----------
Per cent	----------	92.6	2.9	4.5	100.0	----------
March						
1	7	76.5	5.5	----------	82.0	11.7
2	7	109.5	----------	----------	109.5	15.6
3	7	87.0	----------	----------	87.0	12.4
4	6	78.0	----------	----------	78.0	13.0
6	7	108.5	----------	----------	108.5	15.5
7	7	134.0	----------	8	142.0	20.3
8	7	69.0	----------	----------	69.0	9.9
9	7	101.0	----------	----------	101.0	14.4
16	6	85.0	----------	----------	85.0	14.2
18	7	110.5	----------	----------	110.5	15.8
19	7	82.0	----------	----------	82.0	11.9
Total	75	1,041.0	5.5	8	1,054.5	----------
Per cent	----------	98.7	0.5	0.8	100.0	----------
April						
10	7	95	16.0	----------	111	15.9
11	7	97	14.0	----------	111	15.9
12	6	74	11.5	----------	85.5	14.3
13	7	73	----------	----------	73	10.4
14	7	93	3.0	----------	96	13.7
15	7	92	----------	----------	92	13.1
16	7	93	----------	----------	93	13.3
17	7	116	----------	----------	116	16.6
18	7	88.5	----------	----------	88.5	12.6
Total	62	821.5	44.5	----------	866.0	----------
Per cent	----------	94.9	5.1	----------	100.0	----------
May						
4	7	73.5	5.0	----------	78.5	11.2
5	7	66.5	----------	----------	66.5	9.5
9	6	76.0	----------	----------	76.0	12.5
10	6	44.5	13.5	----------	58.0	9.7
11	7	69.5	19.5	----------	89.0	12.7
12	7	85.0	13.0	----------	98.0	14.0
13	7	97.5	1.0	----------	98.5	14.1
Total	47	512.5	52.0	----------	564.5	----------
Per cent	----------	90.8	9.2	----------	100.0	----------
Grand total	260	3,390.0	134.0	57	3,581.0	----------
Per cent	----------	94.7	37.0	1.6	100.0	----------

Average catch per hour in kilograms: February, 14.4; March, 14.06; April, 13.9; May, 12.1. All months combined: 13.62.

[a] Data secured through the courtesy of motorlaunch, *Junior Liner*, a commercial dredge trawler operating in Laguna de Bay during the period.

the haul and the amount was not usually recorded except the few big-sized ones. There was, however, one instance in September, 1950, when the kandule formed 79 per cent of the monthly average haul, exceeding that of biya. The murrel (*Ophicephalus striatus*), fresh-water catfish (*Clarias batrachus*) and mullets (*Mugil* spp.) was also taken as incidental composition of the catch.

There were also included in the haul a number of species of shellfishes which were usually saved by the fishermen for duck feed. These shellfishes consisted of *papan* (*Vivipara angularis*) and *sulib*, *Simpsonella subcrassa* (Table 2). At times the bigger-sized snails were utilized as food by the fishermen. During the period of abundance of these snails in the lake, the fishing efficiency of the goby dredge trawl was very much reduced owing to the clogging of the cod-end of the net. In every haul the catch consisted mostly of shellfishes with a very small percentage of marketable fishes.

It is very interesting to note here that a lone species of aquatic snake, *duhol*, *Chersydrus granulatus* (only known member of the genus from the Philippines) is caught in quantities by the dredge-trawlers in Laguna de Bay. From 4 to 8 snakes, ranging in length from one-half to one meter, are taken per haul during the period of observation. A number of this harmless snake are strung together and at the landing their blood is immediately extracted for tanning dredge-trawl nets and scoop nets (*panalok*) used in the fish corral fishery.

Size of catches.—Tables 3, 4, 5 and 6 show the actual catch record of marketable fishes taken by the three kinds of dredge-trawlers observed from February to September, 1950, in Laguna de Bay.

It will be seen that the total catch of sailboat fishing craft per fishing trip of one day ranged from 14 to 46 kilograms of marketable fish consisting of biya, kandule and dalag. The average catch per hour, using two nets, was 4 kilograms for July and 5.7 for August, 1950, with an overall average of 4.8 kilograms. In motorized fishing craft using two nets, the catch per trip a day was almost within the range of those of the sailboat, being 15 to 42 kilograms, and overall average catch per hour of 4.1 kilograms for September, 1950.

With the motorlaunch *M/S Junior Liner* rigged to one fishing craft and towing four nets, the total catch per fishing day ranged from 58 to 142 kilograms from February through May, 1950, with an hourly average of about 14 kilograms for Feb-

ruary, March and April, and 12 kilograms for May (Table 5). With another motorlaunch *M/S Pasigueño* rigged also to one fishing craft and towing four nets the range of catch of marketable fish was from 48 to 93 kilograms per fishing trip of one day with an average catch per hour of 9.5 kilograms for June and July, 1950 (Table 6).

TABLE 6.—*Analysis by months of catches of motorlaunch-towed fishing craft towing 4 nets in Laguna de Bay, Areas 1 and 2* [a]

Date	Fishing time	Marketable catch				Total catch	Rate of catch
		Biya	Kandule	Ayuñgin	Dalag		
1950	*Hours*	*Kgs.*	*Kgs.*	*Kgs.*	*Kgs.*	*Kgs.*	*Kgs.*
June							
16	7	51.5	8.0	-------	1.0	60.5	8.6
17	6	46.5	23.5	-------	1.5	71.5	11.9
18	7	49.5	12.5	-------	4.5	66.5	9.5
19	7	54.0	29.0	-------	2.5	85.5	12.2
21	7	36.5	6.0	-------	5.5	48.0	6.9
22	7	42.0	13.0	-------	3.0	58.0	8.3
23	6	41.1	4.5	-------	8.0	53.5	8.9
24	7	46.0	1.5	-------	2.0	49.5	7.1
26	8	48.0	43.0	-------	2.0	93.0	11.6
Total	62	415.0	141.0	-------	30.0	586.0	----------
Per cent	-------	70.8	24.1	-------	5.1	-------	----------
July							
3	7	57.5	34.0	-------	1	92.5	13.2
4	7	46.5	28.0	-------	3	77.5	11.1
5	7	30.0	18.0	-------	-------	48.0	6.9
7	7	25.0	21.0	7.0	-------	53.0	7.6
8	7	56.0	13.5	-------	-------	69.5	9.9
Totals	35	215.0	114.5	7.0	4	340.5	----------
Grand total	97	630.0	255.5	7.0	34	926.5	----------
Per cent	-------	68.0	27.6	0.7	3.7	-------	----------

Average catch per hour in kilograms: June, 9.5; July, 9.7; all months combined, 9.6 kilograms.

[a] Data secured through the courtesy of motorlaunch *Pasigueño*, a commercial dredge trawler operating in Laguna de Bay during the period.

It appears from the foregoing rate of catch of marketable fish that the motorlaunch-towed fishing craft landed from two to four times as much as that of the sailboat and motorized fishing craft. This is attributed to the fact that the former towed twice the number of nets, and in actual fishing operation, at least two or three trawl nets fish continuously while one or two are being hauled-in simultaneously.

Size composition of the catch by species.—Tables 7, 8 and 9 and text figs. 7 to 10 show the size composition of samples taken from the commercial catches of sailboat trawlers by species from June to August, 1950, inclusive. It will be seen that the size (body length) composition of biya taken ranges from 60 to 280 millimeters long with the mode at 124 milli-

TABLE 7.—*Length frequency distribution by month of samples of biya (Glossogobius giurus) taken by sailboat fishing craft in Laguna de Bay.*

Standard length	Biya (*Glossogobius giurus*)	
	June, 1950	July, 1950
mm.		
50— 59		
60— 69	1	
70— 79	1	
80— 89	3	1
90— 99	8	17
100—109	20	16
100—119	31	92
120—129	71	88
130—139	54	60
140—149	39	50
150—159	36	34
160—169	23	24
170—179	12	25
180—189	14	15
190—199	7	12
200—209	3	8
210—219	10	3
220—229	3	3
230—239	1	1
240—249	4	1
250—259		1
260—269		2
270—279		1
280—289	2	
TOTAL	343	504

TABLE 8.—*Length frequency distribution by month of samples of kandule (Arius spp.) taken by sailboat fishing craft in Laguna de Bay.*

Fork length	Kandule (*Arius* spp.)	
	June, 1950	July, 1950
mm.		
41— 45	2	
46— 50	1	
51— 55		
56— 60	12	
61— 65	10	
66— 70	10	
71— 75	1	
76— 80	4	
81— 85	2	
86— 90	2	
91— 95	2	
96—100	1	
101—105		
106—110		
111—115		4
116—120		4
121—125		6
126—130		10
131—135		19
136—140		9
141—145		14
146—150		12
151—155		2
156—160		5
161—165		5
166—170		2
171—175		0
176—180		0
181—185		0
186—190		2
191—195		4
196—200		1
201—205		2
Total	47	101

TABLE 9.—*Length frequency distribution by month of samples of ayuñgin (Therapon plumbeus) taken by sailboat fishing craft in Laguna de Bay.*

Standard length	Ayuñgin (*Therapon plumbeus*)	
	June, 1950	July-August, 1950
mm.		
31- 35		1
36- 40		1
41- 45	1	1
46- 50	2	2
51- 55	7	1
56- 60	33	6
61- 65	86	23
66- 70	71	15
71- 75	59	10
76- 80	26	9
81- 85	10	1
86- 90	3	
91- 95	1	
96-100	1	
101-105		2
TOTAL	310	72

meters in June, 1950 (text fig. 7). In July of the same year, the size range of the samples taken was almost the same, but the mode was 114 millimeters, an indication that more of the lower size groups were taken during this month.

With the kandule, the size (fork length) composition of fish taken ranges from 33 to 98 millimeters for June, 1950, with the mode at 58 millimeters, while for July of same year the size ranges from 113 to 203 millimeters long with the mode at 133 millimeters (text figs. 8 and 9). It appears that more of the younger groups were taken during June in the fishery just at the close of the breeding season of the fish.

With the ayuñgin, the size (body length) composition ranges from 33 to 98 millimeters with the mode at 63 millimeters long. For July and August, 1950, the size ranges from 33 to 103 millimeters long, with the mode at 63 millimeters (text fig. 10). It is probable that more of the younger groups would have been measured in the sample were they not thrown back into the water during the fishing operation for being not readily marketable.

Sorting.—The catch (Plate 5, fig. 2) of the dredge trawl consists of an assortment of several species of varying sizes. As soon as the catch is landed on deck the undersized *biya, ayuñgin* and *kandule* are thrown back into the water while still alive. The murrels (dalag) are placed in a separate bag net (*barcelona*); the kandule, biya, and bigger ayuñgin in

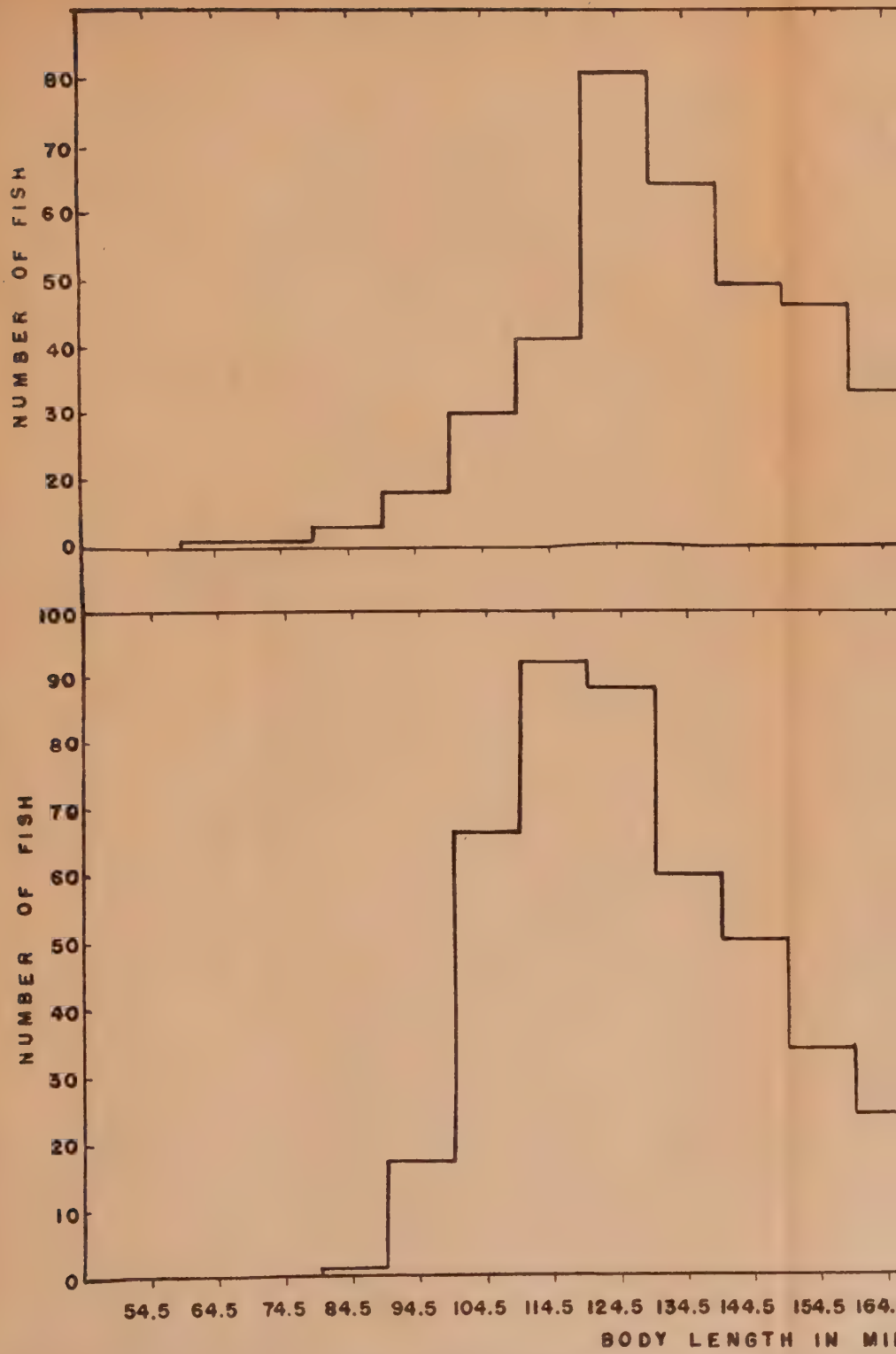
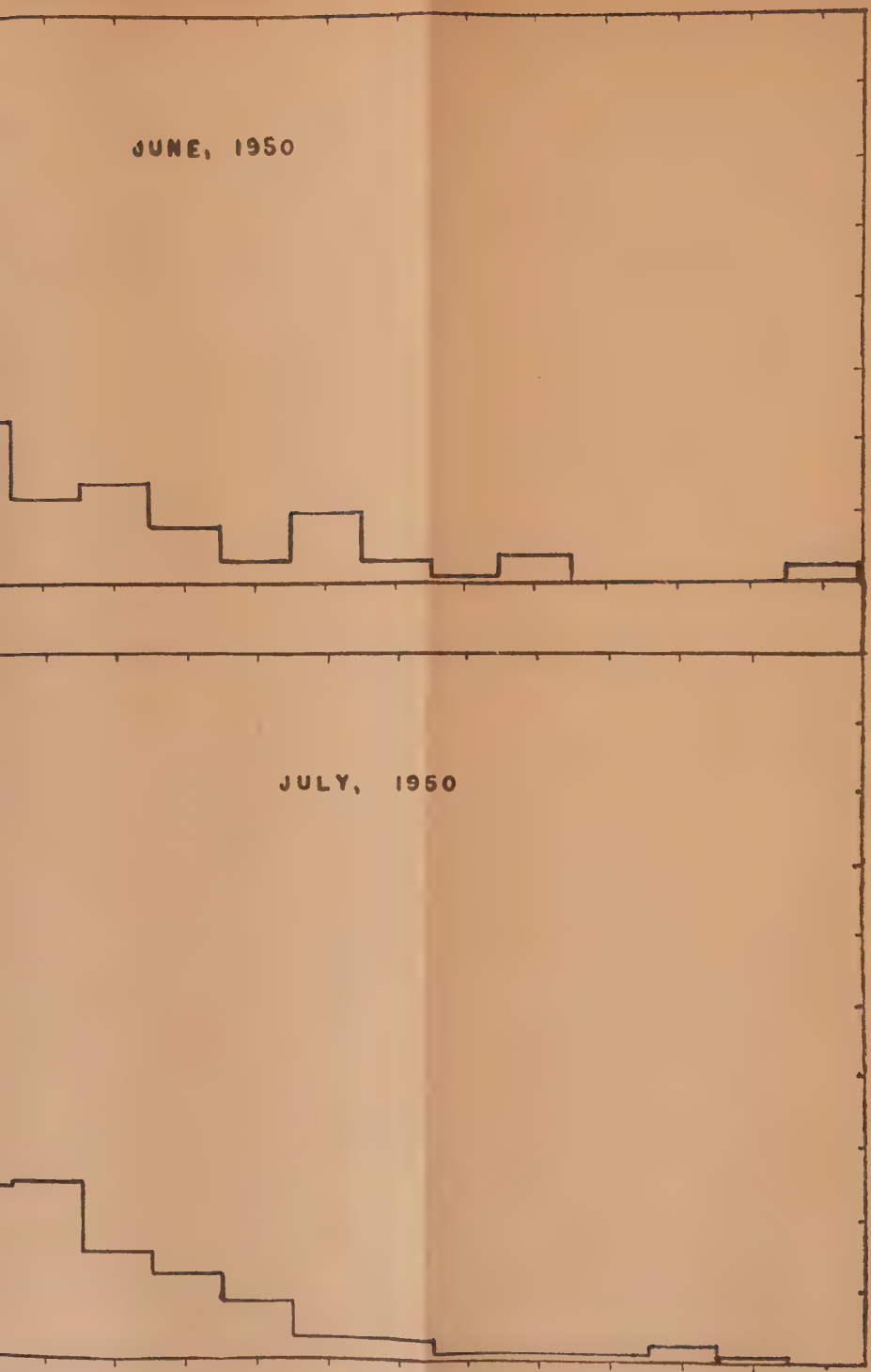


FIG. 7. Length frequencies of samples of biya (*Glossogobius giurus*) taken by sailboat f



hing in Laguna de Bay (based on the figures in Table 7).

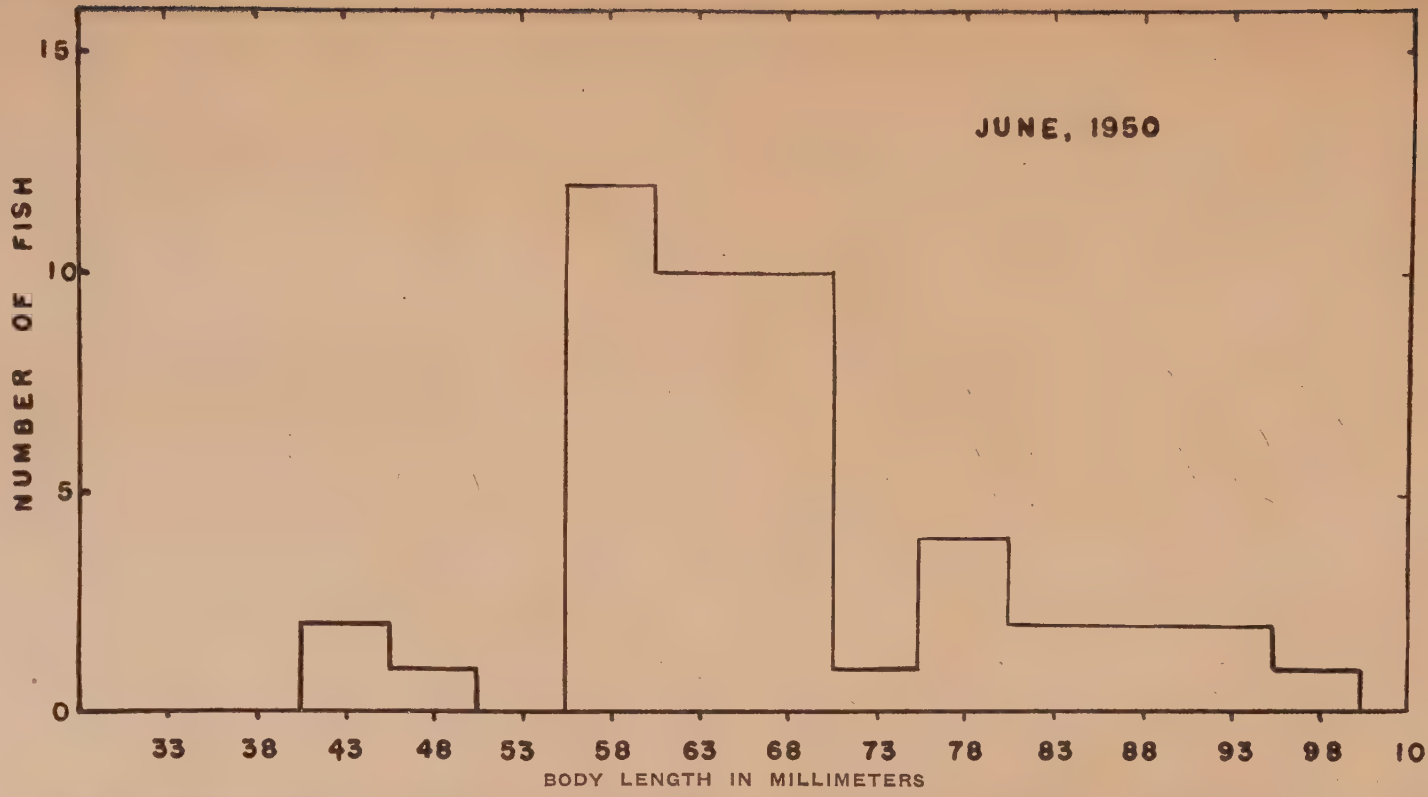


FIG. 8. Length frequencies of samples of kandule (*Arius* sp.) taken by sailboat fishing craft in Laguna de Bay, June, 1950 (based on figures in Table 8).

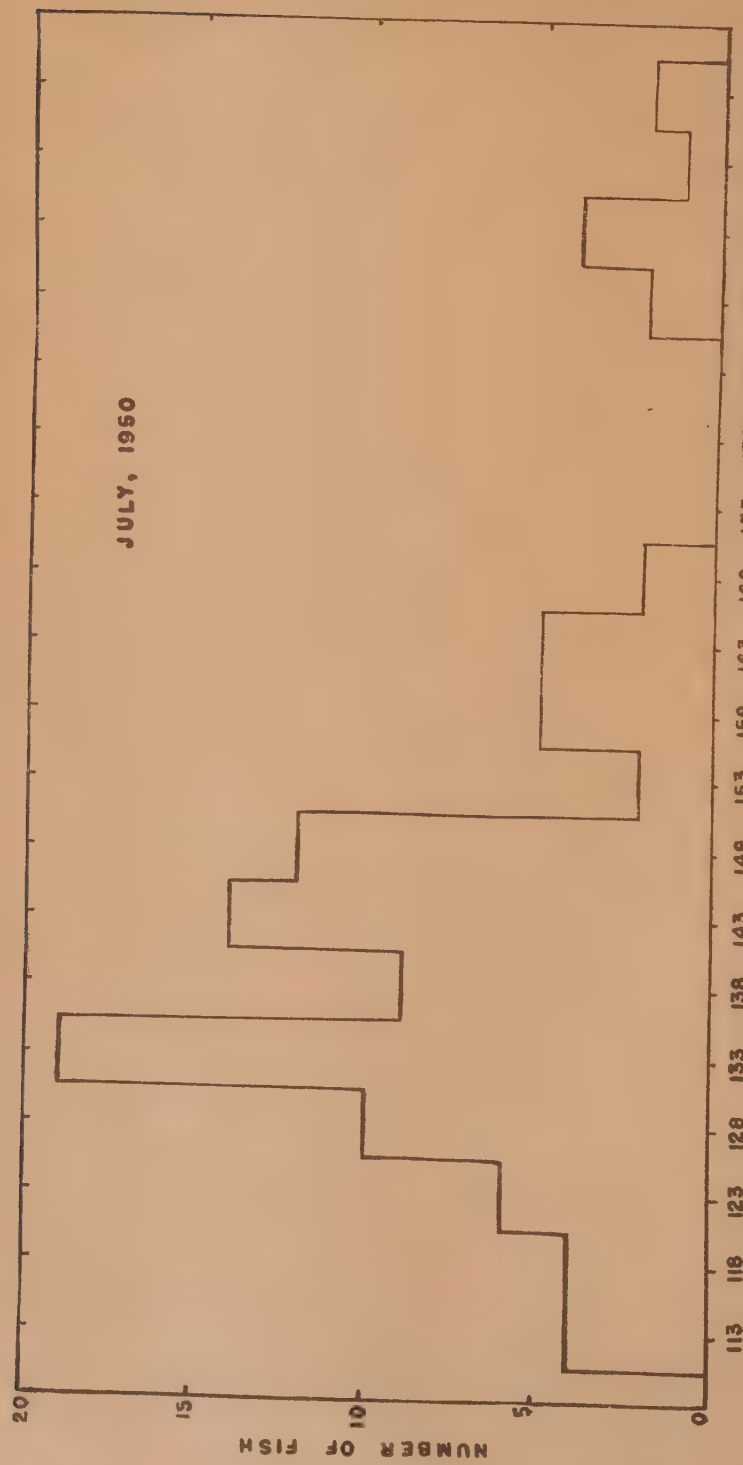


FIG. 9. Length frequencies of samples of kandule (*Arius* sp.) taken by sailboat fishing craft in Laguna de Bay, June, 1950 (basedon figures in Table 8).

separate bamboo containers packed in layers with either banana leaves or some aquatic plants. On board motorlaunch-towed fishing craft, when the hold serves as a livewell, all the selected sizes of the commercial species taken are kept alive. The larger ayungin are sorted and placed in bamboo baskets (*kaing*), and later salted and dried by the fishermen.

No icing of the catch is done aboard the fishing craft except at the fish landing when necessary.

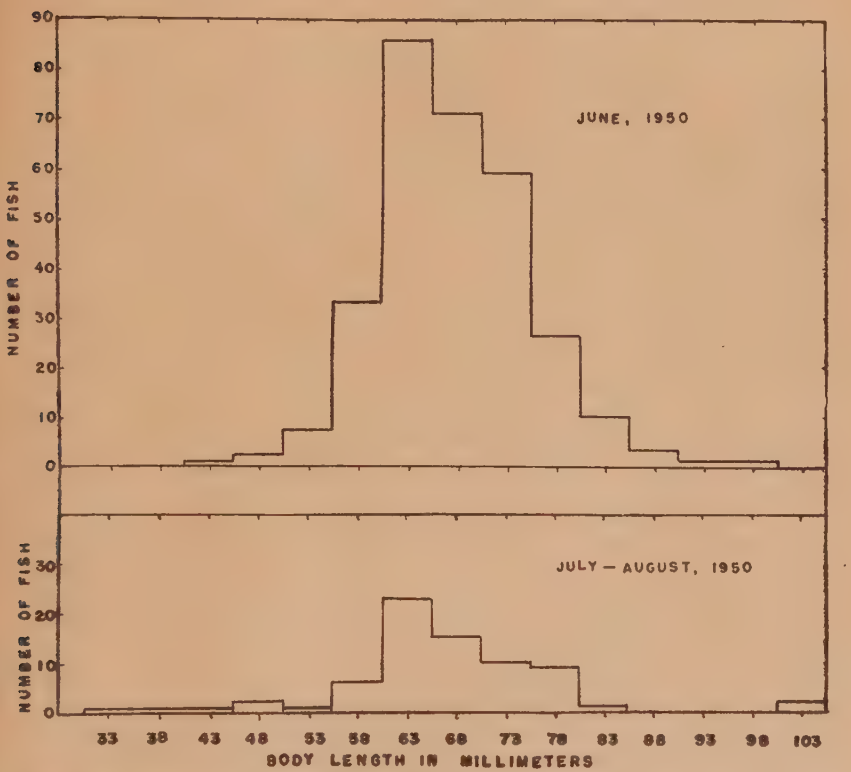

JUNE, 1950
JULY — AUGUST, 1950
NUMBER OF FISH
NUMBER OF FISH
BODY LENGTH IN MILLIMETERS
33 38 43 48 53 58 63 68 73 78 83 88 93 98 103

FIG. 10. Length frequencies of samples of ayungin (*Therapon plumbeus*) taken by sailboat fishing craft in Laguna de Bay (based on figures in Table 9).

SIZE COMPOSITION OF BIYA TAKEN IN RELATION TO THE MESH OF COD-END OF NETS USED

In order to determine the possible destructive effect of the dredge-trawl gear on the biya fishery, a comparative analysis of the size composition of the catch of the three different sizes of mesh of cod-ends of nets used by sailboat fishing craft was undertaken. Tables 10 and 11 show the results for June and

July, 1950, for the three cases. A total of 1,106 individuals taken by a 2.5-centimeter mesh cod-end were measured, 504 for 3.0-centimeter mesh, and 197 for 3.5-centimeter mesh stretched.

TABLE 10.—*Length frequency distribution of biya taken by sailboat fishing craft for June and July, 1950 in Laguna de Bay, by size of cod-end mesh of dredge-trawl net.*

Standard length	Cod-end mesh (stretched)			
	2.5 cm.	3.0 cm.	3.5 cm.	Combined
mm.				
50– 59	3			3
60– 69	21			21
70– 79	62			62
80– 89	56	1		57
90– 99	89	17		106
100–109	139	66	4	209
110–119	182	92	11	285
120–129	194	88	34	316
130–139	134	60	36	230
140–149	91	50	25	166
150–159	72	34	24	130
160–169	26	24	16	66
170–179	18	25	10	53
180–189	6	15	11	32
190–199	5	12	2	19
200–209	6	8	2	16
210–219	5	3	9	17
220–229	1	3	3	7
230–239	4	1	1	6
240–249	1	1	2	4
250–259	1	1		2
260–269		2		2
270–279		1		2
280–289			2	2
Total	1,116	504	192	1,812

TABLE 11.—*Percentage composition of immature and mature biya taken by sailboat fishing craft in June and July, 1950, by size of mesh of cod-end of net used.*

Cod-end mesh (stretched)	Immature fish		Mature fish		Total
cm.	*Number*	*Per cent*	*Number*	*Per cent*	
2.5	746	66.84	370	33.16	1,116
3.0	264	52.38	240	47.62	504
3.5	49	25.52	143	74.48	192

Using 125 millimeters [3] as the mean standard length at sexual maturity of biya, the percentage composition of immature and mature fish taken in the commercial haul was determined. From this analysis of 1,812 specimens examined, it was found that 66 per cent of the samples taken by 2.5 cm. cod-end mesh were immature; 52 per cent by 3.0 cm. mesh; and 26 per cent

[3] Mean size at sexual maturity was determined in a separate study undertaken by the authors during the same period of observations.

by the 3.5 cm. mesh. Conversely, an increased percentage of mature fish becomes evident as the size of the cod-end mesh increases (text fig. 11). The larger meshes appeared to have provided sufficient "escapement" of immature fish to reach maturity in order to spawn and replace the stock. The use of larger meshes in the trawl fishery in the North Atlantic and the West Coast of America is an accepted practice as established by regulatory measures in protecting the immature groups and allowing the fish to spawn even once before they are caught.

DISPOSAL OF THE CATCH

The catch of the dredge-trawlers in Laguna de Bay are usually disposed in three important landings; namely, Pasig and Binangonan, Rizal Province, and Biñan, Laguna. Binangonan and Biñan are the homeports of most sailing boat and motorized fishing craft (Plate 1, figs. 1–2) and Pasig for most motorlaunch, towed fishing craft.

The catches of motorized and sailboat fishing craft are usually marketed in the morning. At the landing, the fish are mostly kept alive in the livewell of the fishing vessel or in live-boxes or crates (bamboo or G.I. wire netting) placed in the lake. The bigger-sized dead fishes upon landing are iced in bamboo baskets while the small-sized biya are kippered, salted and dried (Plate 4, fig. 2). The ayungin are soaked in brine overnight, dried under the sun and staked in pieces of bamboo sticks known locally as "*karingkaring*." The kippered biya are also staked in pieces of bamboo sticks. Both are sold by the hundreds of stakes.

The catches of the motorlaunch-towed fishing craft are sold direct to the fresh fish market in Pasig, Rizal, the fish being kept alive in the livewell during the entire fishing trip. Most of the fish landed in Binangonan and Cardona, Rizal, are transported by trucks to Manila markets early in the morning. In Biñan, Laguna, the fish are transported by trucks to Batangas, Cavite and Laguna town markets.

The wholesale price of the large marketable fresh biya per kilo ranged from 60 to 80 centavos,[4] the small biya, 20 to 40 centavos. At the landing dead biya are usually sold half the price of the live ones. The kandule is considered a delicacy in Laguna and Rizal Provinces and the wholesale price usually ranges from 90 centavos to one peso per kilo.

[4] One centavo is equivalent to one-half cent U. S. currency.

Tanning of trawl nets.—Trawl nets are usually tanned every week. The nets are first tanned in a solution of macerated bark of *bakawan* (*Rhizophora candelaria* DC.) and later treated with the blood extracted from an aquatic snake, *duhol,* taken in the hauls. The blood treated nets are dried under the sun and steamed in order to coagulate the blood proteins completely. The net is now ready for use after this treatment.

SUMMARY

A comparatively new fishery was developed and established in Laguna de Bay with the introduction of an indigenous goby dredge-trawl gear, locally called *"kaladkad pangbiya"*, used in the catching of demersal species.

As to mode of propulsion, the fishing craft are classified in three categories; namely, sailboat, motorized and motorlaunch-towed boats. The fishing craft proper consists of the conventional dugout measuring from 12 to 14 meters long, 1.0 to 1.3 meters wide and about a meter deep; about one ton gross capacity.

The rigging of the fishing craft and gear, the fishing operation, handling and marketing of the catch are fully described.

The rate of catch per hour varies in the three kinds of fishing craft used, 4.5 kilograms for sailboat and motorized craft and 12.0 kilograms for motorlaunch-towed vessel. The rate of catch by depth and by area was not ascertained in this study.

The dredge-trawl catches consist of six species of fish represented by six families, five species of shellfishes and a lone species of aquatic snake, *Chersydrus granulatus.* The biya (*Glossogobius giurus*) formed from 65 to 95 per cent of the haul, followed by kandule (*Arius* spp.) and dalag (*Ophicephalus striatus*). The ayuñgin (*Therapon plumbeus*) is generally considered a trash fish in the catch.

The composition of the catch by species was found to range from 54 to 280 millimeters (body length) for biya; 33 to 203 millimeters (fork length) for kandule, and 33 to 98 millimeters (body length) for ayuñgin.

The percentage composition of immature and mature biya taken varies with the different cod-end mesh of nets used. For 2.5-centimeter mesh, 66 per cent was found to be immature; for 3-centimeter mesh, 52 per cent; and for 3.5-centimeter mesh, 24 per cent.

The dredge-trawl nets are tanned with a combination of extracted blood of fresh-water snake and of *bakawan* (*Rhizophora candelaria*) cultch.

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ILLUSTRATIONS

Plate 1

Fig. 1. Sailboat fishing craft anchored or beached at Kalinawan, Binangonan, Rizal Province.
2. Barrio Kalinawan, Binangonan, Rizal, a home port of sailboat and motorized fishing craft in Laguna de Bay.

Plate 2

Fig. 1. Sailboat fishing craft in operation on the eastern portion of Laguna de Bay.
2. Sailboat fishing craft towing two nets in Laguna de Bay.
3. A typical sailboat fishing craft in actual fishing operation in Laguna de Bay.

Plate 3

Fig. 1. A dredge-trawl frame maker, Kalinawan, Binangonan, Rizal.
2. Finished dredge-trawl frames, Kalinawan, Binangonan, Rizal.

Plate 4

Fig. 1. A typical dredge-trawl net laid out with its coiled tow line.
2. Kippered biya (*Glossogobius giurus*) taken by dredge-trawler strung in pointed bamboo sticks being dried under the sun, Binangonan, Rizal.

Plate 5

Fig. 1. Hauling-in a dredge-trawl net on a sailboat fishing dugout. Note fish at the cod-end.
2. A typical haul of fish spread on deck of a sailboat fishing craft. Note the catch of fish and snails on the side of the deck, Laguna de Bay.

Text figures

Fig. 1. Map of Laguna de Bay showing divisions of reference areas.
2. Deck plan of a typical sailboat fishing craft towing one to two dredge-trawl nets (diagrammatic).
3. Deck plan of a typical motorized fishing craft towing one to two dredge-trawl nets (diagrammatic).
4. Motorlaunch-towed fishing craft in operation towing four dredge-trawl nets (diagrammatic).
5. Dredge-trawl frame (A) side view, (B) top view and (C) dorso-lateral view (diagrammatic).
6. *a*, Cutting diagram of a piece of netting 3-centimeter stretched-measure mesh No. 6 seine twine, 150 × 190 meshes, for making typical fish dredge-trawl net. *b*, The dredge-trawl net after joining the sections shown in figure 6. Joining is done by meshing the various parts together. To form the dredge-trawl net fold-over the top section over the bottom section so that A join with B and A′ with B′ to a point 10 M below the top edge to form the upper flap. Likewise C and C′ is joined with E and D and D′ with E′.

7. Length frequencies of samples of biya (*Glossogobius giurus*) taken by sailboat fishing craft in Laguna de Bay (based on the figures in Table 1).
8. Length frequencies of samples of kandule (*Arius sp.*) taken by sailboat fishing craft in Laguna de Bay, June, 1950 (based on figures in Table 2).
9. Length frequencies of samples of kandule (*Arius sp.*) taken by sailboat fishing craft in Laguna de Bay, July, 1950 (based on figures in Table 2).
10. Length frequencies of samples of ayuñgin (*Therapon plumbeus*) taken by sailboat fishing craft in Laguna de Bay (based on figures in Table 3).
11. Length frequencies of samples of biya (*Glossogobius giurus*) taken by different sizes of mesh of cod-end used by sailboat fishing craft in Laguna de Bay, June and July, 1950 (based on figures in Table 10).

AN OUTLOOK OF THE PHILIPPINE TUNA FISHERIES [1]

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The commanding position of the tunas in the world's fisheries attracts an increasing attention to the exploration of tropical waters. Lying within this belt of warm waters, the Philippine seas naturally constitute an integral unit of the great tuna fisheries of the Asiatic quadrant of the Pacific, which in the past had produced 78 per cent of the Pacific tonnage. Realizing this potentiality of Philippine waters for tuna exploitation ventures, the Philippine Bureau of Fisheries plans to launch a large scale investigation of the areas that bear promise of excellent yields in the light of our present knowledge of the oceanography of Philippine waters. Such areas as southeastern Mindanao, where the Pacific Equatorial Current begins, and northeastern Luzon which is known to be within the path of tuna migration will be intensively investigated. For this purpose, the 187-ton *M/S Fisheries* of the Philippine Bureau of Fisheries will be used.

Aside from the tuna exploration work carried out by the Japanese in scattered areas in the Philippines, there has been no systematic survey undertaken within our territorial waters for exploiting the tunas, more particularly the yellowfin, which abounds in our high seas. The Philippine Fishery Program of the United States Fish and Wildlife Service made several attempts using the well-known Japanese longline. Although the results obtained were not altogether encouraging, undoubtedly on account of the paucity of factual oceanographic data, the exploratory work has led to an appreciation of the importance of collecting oceanographic information and correlating it with the tuna catch. This scheme of making hydrographic observations hand-in-hand with tuna fishing operations has been widely practiced by the Japanese, who have developed the tuna long-lining technique to a high degree of efficiency.

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[1] Contribution of the Philippine Delegation to the Third Meeting of the I.P.F.C. at Madras, February 1–16, 1951.

Confident of the success of this type of subsurface fishing for tunas, the Pacific Fishing Development Company of the Philippines recently acquired two tuna boats of about 50 tons capacity each. Equipped with the long-line and manned by experienced Taiwanese fishermen, the *M/V Nelly* and the *M/V Dinia* have fished several areas, principally the Sulu and Celebes Seas. Although their catch records do not show figures close to the reported Japanese catch ratio of 7.0 for Sulu Sea and 9.5 for Celebes Sea, the results show promise of economic possibility. A break-down of the catch of the *M/V Nelly* in two of its trips is found in the accompanying tables.

TABLE 1.—*Summary of catch: First trip.*

Date	Fishing grounds (sea)	Number of fishing hours	Number and weight of catch			Total number daily catch
			Tuna	Shark	Swordfish	
1950 August						
14	Sulu Sea Central Part	18.5	24 1,500 kg.		2 150 kg.	26 1,650 kg.
15	do	18.5	24 1,470 kg.	7 200 kg.	6 1,010 kg.	37 2,683 kg.
16	Sulu Sea Southern Part	18.0	17 1,800 kg.	12 1,955 kg.		29 3,755 kg.
17	do	18.8	6 420 kg.	7 850 kg.	2 270 kg.	15 1,540 kg.
19	Sulu Sea Eastern Part	17.8	9 450 kg.		3 30 kg.	12 480 kg.
20	Sulu Sea Northeastern Part	17.5	18 900 kg.	2 200 kg.	2 650 kg.	22 1,750 kg.
21	do	17.8	12 600 kg.	2 120 kg.	1 40 kg.	15 760 kg.
22	do	17.0	13 780 kg.	3 150 kg.	4 200 kg.	20 1,130 kg.
		143.9 hours or 6 days	123 7,920 kg.	33 3,475 kg.	20 2,550 kg.	176 13,945 kg.

Total (in tons), 13,945 (long).

TABLE 2.—*Summary of catch:*[a] *Second trip*

Date	Tuna	Swordfish	Sail fish	Sharks	Barracuda
9-22-50	10	2	0	4	
9-24-50	6	3	0	5	
9-25-50	8	0	1	1	
9-27-50	3	1	0	1	
9-28-50	1	2	1	1	
9-30-50	7	4	3	4	
10-1-50	6	1	5	3	
10-6-50	3	3	0	2	2

[a] The smallest tuna weighed 45 kilos, while the sailfish averaged 100 kilos each.

The data reveal much interesting information basic to the understanding of the causes underlying the success or failure of tuna fishing in those areas. The yellowfin tuna dominated the catch. Even at subsurface levels, there was evidence of predation by sharks which are normally surface-feeders. In

August and September when the warm waters from the lower latitudes must have reached their northernmost displacement, tunas were still found in the two fishing grounds.

The above information demonstrates the value of a knowledge of certain oceanographic factors in tuna-long-line operations. Of these factors, temperature, current drift and set, transparency and bottom topography are the most important in the light of the Japanese observations gathered in the tropical regions of the Pacific. Based on the Japanese investigations, the best catches were made in waters the temperature of which from the surface to a depth of 100 meters was over 20° C., transparency between 25 to 35 meters and current drift between 0.5 and 1.5 knots.

EQUIPMENT AND METHODS USED IN OCEANOGRAPHIC INVESTIGATIONS IN THE PHILIPPINES [1]

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ABSTRACT

In the Philippines, oceanographic investigations are carried out with the equipment and instruments turned over to the Bureau of Fisheries by the American Government, following the termination in 1950 of the Philippine Fishery Program of the United States Fish and Wildlife Service. The methods and chemical procedures being followed are patterned after those in practice at the former Oceanographic Laboratories of the University of Washington, U. S. A. Slight modifications in carrying out the chemical determinations have been adopted to suit local needs. Nomenclature and units are in accordance with international standards.

The importance of conducting cooperative oceanographic investigations in the Indo-Pacific region emphasizes the need of using uniformly reliable and accurate equipment and instruments, standardizing methods, nomenclature, and units. The information herein offered is intended to stimulate interest in filling this need, and invite complementary information from different countries of the region.

The equipment and instruments now in use by the Philippine Bureau of Fisheries are not the latest in design and construction, nor are they complete to enable us to carry out a comprehensive research program. Our methods and procedures, on the other hand, are an adaptation of the standardized system followed by the defunct Philippine Fishery Program of the United States Fish and Wildlife Service.

EQUIPMENT

Boat.—The M/V *David Starr Jordan* of the Bureau of Fisheries was acquired in May, 1950, as part of the equipment and supplies turned over to the Philippines after the termination of the Philippine Fishery Program. Completely rebuilt by the Grandy Boat Building Company of Seattle, Washington, the boat was outfitted for otter trawling operation in Philippine

[1] Contribution of the Philippine Delegation to the Fourth Meeting of the I.P.F.C. at Quezon City, Philippines, October 23 to November 7, 1952.

waters by the United States Fish and Wildlife Service. Although its winch is not suitable for working high-speed oceanographic gear, the boat is stable, seaworthy and highly maneuverable. An after-deck affords ample space for the work-table used in the shipboard chemical work. The walls of this table serve as racks for a battery of 15 water bottles.

The principal dimensions of the vessel are: overall length, 16.2 meters; length at water line, 14.6 meters; breadth, 4.0 meters; and draft, 2.0 meters. The 30-ton vessel is driven by a 135-horsepower Murphy diesel engine, giving a cruising speed of six knots.

The sampling gear is made up of the starboard drum of the drag winch which can pay out the $\frac{5}{32}$-inch hydrographic wire at the rate of two meters per second, and retrieve it at about one-sixth that rate. From the starboard drum the wire passes through a sheave fastened to the seaside of the gunwale, then to the meter wheel, and thence into the water. Shocks due to uneven motions of both boat and sea are absorbed by the accumulator which is suspended above the meter wheel. The accumulator is in turn hung from the free end of the davit used as boom. This sampling set-up, though not in accordance with standard practice, has met our requirements even under adverse sea conditions.

Thermometers.—The deep-sea reversing thermometers being used are a part of the 497 Japanese thermometers which were turned over to the Philippines as part of the reparations of World War II. Fifty-seven thermometers from this stock were used by the Philippine Fishery Program, and these are the same instruments being used by the Philippine Bureau of Fisheries at the present time. They were manufactured by the Watanabe Keiki Manufacturing Co., Tokyo, Japan.

These thermometers bore no calibration certificates; hence, the corrected temperatures based on headings taken from them are only relative. Personnel of the Philippine Fishery Program had calibrated these instruments against two Richter and Wiese thermometers, but the certificates of these two reference thermometers also are not available at present.

The performance of these Japanese-made thermometers has been, as a whole, thoroughly satisfactory. A comparison of the *Baird* temperatures with those of the *Snellius* for the deep water of the Sulu Basin showed good agreement (Graham, 1949). Two of these Watanabe thermometers were tested by the "Galathea" in the Mindanao Deep in August, 1951, and

they were able to withstand a pressure of 815 atmospheres. The thermometers give readings consistently reliable to 0.02° C.

Water bottles.—Water samples are taken using the two-plug valve-type Nansen bottle of liter capacity. This type of bottle has the advantage over the modified flap-type Nansen sampler in that its reversing mechanism can be tripped by a lighter messenger. Its drawbacks, however, are: it is apt to close prematurely, and samples taken at subsurface levels may get contaminated while in transit to the upper layers of the water column, due to malfunctioning of the valves caused frequently by rough sea conditions.

STATION POSITIONS

Stations are predetermined, arbitrary, geographic positions, where the boat stops to take water samples. The choice of station position is dictated by the need of representative sampling, and by such factors as topography, nature of water circulation, and type of survey desired. On account of the fact that almost all the areas now under investigation are littered with war debris, these snags are taken into consideration in laying out the stations.

In areas adjoining the open sea, the stations are invariably distributed grid-fashion, such that the line of stations so laid cuts across the expected current. In island-studded spaces, where pockets of topographically isolated areas indicate basin conditions, stations are established over the deepest portion of the area and also over the effective sill or deepest threshold.

PROCEDURE AT STATION

Once the station is fixed, sampling is immediately commenced. Where more than one cast is necessary, the deepest cast is made first. If wind or water current causes the wire to incline to more than 8°, the boat is maneuvered to set the wire in nearly vertical position. However, a protected and an unprotected thermometers are always paired at appropriate levels to insure, during reduction of the data, the application of displacement corrections on wire depths recorded in cases when the wire angle unavoidably exceeds 8°. Messengers have been clocked at a speed of 200 meters per minute; this rate of descent affords the basis for determining when to haul the cast. Five minutes for shallow casts and 10 minutes for deep casts are allowed for the bottles and thermometers to attain thermal equilibrium with their surroundings.

Once aboard, the thermometers are read first and then samples for the chemical determinations are drawn in the following order: oxygen, phosphate, silicate, pH, and chlorinity. Chlorinity samples are taken to the shore-based laboratory where the analyses are made.

Plankton tows are run in between stations. Vertical plankton samplings are done after the water samples are in.

Owing to the slow speed of the winch, bathythermograph measurements have not been made a regular part of the hydrographic routine. Bathythermograph observations, whenever made, always precede the hydrographic sampling.

SERIAL OBSERVATIONS

Water samples are taken at the surface, and at 2, 5, 10, 20, 30, 50, 75, 100, 150, 200, 300, and 500 meters below the surface. In deeper areas, the first five standard levels below the surface are omitted; samples at 25 meters are taken instead. In shallow areas bottom samples are taken at a few meters above the bottom.

Samples are not regularly taken at depths greater than 500 meters, because below this level, seasonal changes in Philippine waters are believed to be no longer operative or are at a minimum.

In the top layers, it is desirable to shorten the sampling intervals. These intervals are, however, limited by the length of the Nansen bottles, which cannot be operated in series at less than one-meter intervals on the line.

ANALYTICAL PROCEDURES

With the exception of the pH determination, all the analyses are based on unpublished mimeographed notes prepared by Thompson and Robinson of the Oceanographic Laboratories of the University of Washington. In the following discussions of the analytical procedures, no attempt has been made to describe the chemistry of the method, nor the details of the procedure. These are amply covered in relevant literature. Only such modifications as have been adopted to suit our purpose have been treated.

Chlorinity.—The amount of halogens in the sample is determined by a modification of the Oxner–Knudsen method using a Knudsen bulb, burette, and a 15-ml. automatic tap pipette. A bulb flask, filled with a weak solution of potassium chromate and set before an artificial light, has proved to be a handy

aid in sharpening detection of the end point of the titration. Standardization is against a secondary sea-water standard whose chlorinity has been fixed by Woods Hole standard sea-water. Copenhagen water will be used, after we have exhausted our present stock of secondary sea-water standard.

The preparation of a secondary standard sea-water is covered by Lyman's procedure. A slight modification that we have found highly desirable is the dipping of the tops of the citrate bottles containing the secondary standard sea-water in molten paraffin wax to insure their seal.

Chlorosity values are converted into chlorinities using the table for conversion of Cl/l at 20° C. to Cl°/$_{oo}$ prepared by Thompson (1928, 1930). In line with standard practice, salinities are used in dynamic computations.

The chlorinity determinations are believed to be accurate to within 0.02°/$_{oo}$.

Dissolved oxygen.—Dissolved oxygen is determined using the Winkler titration method. In line with more recent practice, however, we are using a standard potassium iodate solution of 0.01 normality. In order to get more significant figures for titration volumes, we have also adjusted the concentration of our sodium thiosulfate solution to about 0.005 normality. Sodium furoate is used in the amount of 0.1 per cent by weight to inhibit bacterial action. The buffering action of this chemical makes it unnecessary to boil out carbon dioxide from the water used in preparing the thiosulfate solution (Jentoft, 1949). As an inhibitor of the growth of mold in the starch indicator, we use a pinch of mercuric iodide regularly.

The routine precision of the determination is about 0.002 mg. atom, or 0.02 ml./l of sea-water.

Inorganic phosphates.—The method of Deniges is the basis of the determination of soluble phosphates in sea-water. To avoid applying the customary salt error correction on the phosphate values, synthetic sea-water of about 18°/$_{oo}$ chlorinity is used in diluting the standards for comparison. This is prepared by dissolving 33.6 grams of sodium chloride in a liter of phosphate-free distilled water.

The accuracy of the determination is of the order of 5 per cent to 10 per cent.

Silicates.—Silicates are determined by using the method developed by Dienert and Wadenbulcke as applied by Atkins to oceanographic work. For comparison, we have been using the "preferred standard of potassium chromate", rather than the

"alternate method" of using picric acid as standard. The latter keeps unchanged in its chemical properties for a period of months, the former even longer. As in the colorimetric determination of inorganic phosphates, Nessler tubes are used in measuring the silicate content of water samples.

Hydrogen-ion.—The pH is measured with the Beckman pH meter.

NOMENCLATURE AND UNITS

The scheme of nomenclature and units adopted follows that of the *Baird.* Chlorinity and salinity are expressed in parts per mille of weight in accordance with the definition on which the Knudsen Hydrographic Tables are based. To-date our areas of investigations have been always confined to coastal and inland seas, and so dynamic computations of currents for these regions have not been deemed practicable. Therefore, except in cases when water masses are examined or oxygen values computed for degrees of saturation, we have always used chlorinity in expressing halogen concentration.

Oxygen values are expressed in milligram-atoms or in milliliters/liter at 27.5° C., a unit useful to physical oceanographers, and on the basis of percentage saturation, which is the more preferred unit in biological studies. The degree of saturation includes the effects of temperature and salinity, and provides a measure of availability to organisms.

The concentration of nutrient salts is expressed in microgram-atoms/liter of sea-water at 27.5° C.

For purposes of volume measurements, we have adopted 27.5° C. as our standard temperature, although the indicated temperature of calibration of our laboratory glassware is at 20° C. The error introduced in using this standard room temperature in the Philippines is insignificant, compared to the error in the determination of chlorinity, which has the highest accuracy of all the chemical analyses run on our water samples.

In all other cases involving measurement, the metric system has been adhered to in line with IPFC practices.

SUMMARY

1. The 30-ton combination fishing vessel, M/V *David Starr Jordan,* was rigged with a crude hydrographic sampling set-up which permitted the collection of water samples from moderate depths within a tolerably short time. A portable compact work table mounted on the after deck provided the facilities for the shipboard analysis of the water samples.

2. The Japanese-made, deep-sea reversing thermometers used, gave readings consistently accurate to within 0.02/C. The water bottles were of the Nansen plug-valve type of liter capacity.

3. Bathythermograph observations and vertical plankton sampling, whenever made, preceded and followed respectively, the hydrographic sampling. Plankton tows were run in between stations. Water samples were ordinarily taken at the surface, and at 2, 5, 10, 20, 30, 50, 75, 100, 150, 200, 300, and 500 meters below the surface.

4. Chlorinity was determined using the modified Oxner–Knudsen method. Standardization of the titer was against a secondary sea-water standard whose chlorinity had been determined, using Woods Hole standard sea-water.

5. Dissolved oxygen was determined by the modified Winkler method. The strength of the thiosulfate solution was adjusted to half the standard normality to gain more significant figures for titration volumes. Oxygen content was expressed in mg-atoms/l or ml/l.

6. Inorganic phosphates were determined using synthetic sea water of about $18°/_{oo}$ chlorinity for diluting the standards. For comparison, in the determination of silicates, a series of potassium chromate standard solutions were used. The concentrations of the chemical nutrients were expressed in microgram-atoms/l.

7. The standard temperature used was 27.5° C.

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DEVELOPMENT OF A COAL-TAR NET PRESERVATIVE[1]

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FIVE TEXT FIGURES

ABSTRACT

Undiluted coal tar net preservative does not easily dry in a warm climate, thus making the net too heavy, messy, and hard to handle. To solve this problem, a coal tar net preservative diluted with gasoline was developed with the purpose of revolutionizing net preservation in the Philippines, where tan bark extract and blood are commonly used. The diluted preservative reduces the amount of coal tar deposited in the gear to an extent that the increase in weight is quite negligible.

Diluted coal tar showed preserving qualities on cotton twines exposed to the atmospheric weather and on those immersed continuously or intermittently in brackish and marine waters. However, the imported diluted coal tar containing rosin showed better preserving qualities.

Coal tar is a mineral product obtained by the destructive distillation of bituminous coal at 1100°–1300° F. together with coal tar and other ammoniacal compounds inherently present in coal. On further fractional distillation of coal tar, antiseptic compounds such as phenols, creosote, naphthols, pyrimidine bases, etc., are produced. The protective coating which coal tar provides and its antiseptic property are responsible for its use as an efficient net preservative against the destructive effects of microorganisms and abrasion so that, although careless handling and improper care of gear are often responsible for some losses, the use of coal tar is justified and lessens such risks.

Taylor (1920, 1923) and Conn (1930), in their pioneering studies on net preservatives, recommended coal tar as a net bactericide and as a protective coating against abrasion. Because coal tar is insoluble in water, it renders the gear impervious to water, thereby enhancing quick drying even in the shade. This is highly desirable because sunlight causes rapid deterioration brought about by oxidation.

There are objections to the use of undiluted coal tar as a net preservative, most important of which are the tremendous

[1] Contribution of the Philippine Delegation to the Fourth Meeting of the I.P.F.C. at Quezon City, Philippines, October 23 to November 7, 1952.

increase in the weight of the gear, handling difficulties, and fire hazards. In tropical countries, the climatic condition renders the nets too messy and therefore hard to handle. But as early as 1920, Taylor recommended a mixture of coal tar and copper oleate diluted with benzene, a volatile organic solvent. Johnson (1947), Technical Adviser of the Commonwealth Training School at Cronulla, advocated a mixture of 4 parts of coal tar, 1 part diethylene and 2 parts water as an efficient net preservative. At boiling point, penetration of the resulting solution is instantaneous, resulting in a more practical and less laborious application.

Whiteleather and Brown (1945) admitted that coal tar should not be recommended as a net preservative in the tropics. However, if coal tar is diluted with a suitable volatile organic solvent, it need not be heated to promote instantaneous penetration into the twines or nettings. After removing the excess material by pressing, drying can be accomplished in a matter of a few hours only. Firth (1945, 1948) and Conn (1930) recommended gasoline as a much better solvent for coal tar because of its high volatility and availability. The use of this solvent as a thinner reduces the amount of coal tar deposited in the gear to an extent that the increase in the final weight is quite negligible.

Farrar (1950), Robertson (1930), Bright (1926), Dubos (1928), Fleming (1921), McBeth (1913), and Carrothers (1949) are among the workers who claimed that one of the causes of net deterioration is bacterial in nature. Therefore, the use of coal tar would serve efficiently against such, because it contains as main constituents antiseptic compounds such as phenols, creosote, naphthols, pyrimidine bases, etc. Robertson also proved that weathering deteriorates nets, although drying causes less bacterial action due to lack of moisture. The deterioration effect is caused by oxidation. More damage is produced in the presence of chemicals like the copper compounds. In this connection, coal tar-treated nets should be hung and dried in the shade with an abundance of circulating air.

In undertaking this study, we aimed to determine a coal-tar-gasoline solution or mixture which would be most effective against deterioration of cotton twines subjected to various conditions such as weathering, continuous and intermittent immersion in both sea and brackish waters. It is hoped that the use of such preservative may revolutionize net preservation

in the Philippines from the standpoint of cost of labor, practicability, and interval of treatment.

MATERIALS AND METHODS

Materials.—The brand of coal tar used in this experiment was the master mineral black coal tar distributed by a local firm. It is soluble in organic solvents such as acetone, carbon tetrachloride, ether, chloroform and gasoline. It is partly soluble in kerosene. If used as a diluent, any of the aforementioned solvents may be used to make the solution.

Another brand of imported commercial net preservative used in this experiment was the "Texaspaltic Net Drip" manufactured by the Texaspaltic Company, New Orleans, Louisiana, U. S. A. It is claimed to protect nets from rots and abrasion. It contains rosin, coal tar, texaspaltic acid, benzene, and an alkali-proofing compound. In the label may be found the following directions: "Have nets thoroughly dry and clean. Completely saturate with undiluted net drip. Hang to dry for 24 hours. Nets will then be ready to use."

As a diluent, gasoline was used from the standpoint of price and availability. The following is a classified list of the canvassed prices of suitable organic diluents for coal tar:

1. Coal tar, 5 gallons	₱17.50
Kerosene, 1 gallon	0.67
Chloroform, 1 gallon	27.00
Total	₱45.17
2. Coal tar, 5 gallons	₱17.50
Kerosene, 1 gallon	0.67
Carbon tetrachloride, 1 gallon	7.80
Total	₱25.97
3. Coal tar, 5 gallons	₱17.50
Kerosene, 1 gallon	0.67
Acetone, 1 gallon	3.00
Total	₱21.17
4. Coal tar, 5 gallons	₱17,50
Kerosene, 1 gallon	0.67
Gasoline, 1 gallon	0.88
Total	₱19.05

5. *a.* Coal tar, 5 gallons	₱17.50
Gasoline, 2 gallons	1.76
Total	₱19.26
b. Coal tar, 5 gallons	₱17.50
Gasoline, 3 gallons	2.64
Total	₱20.14
c. Coal tar, 5 gallons	₱17,50
Gasoline, 4 gallons	3.62
Total	₱21.12

The cotton twine used was the No. 9, 3-ply, available in 1-lb. bundles. The brand was the international Seine Twine, manufactured and distributed by the International Company, U. S. A.

Methods.—The cotton twine was cut into equal lengths of 30 inches. A total of 30 bundles consisting of 175 pieces of the prepared twine were used. The bundles were divided into 5 parts, designated as A, B, C, D and E. In order to identify one from another, the twines were knotted as follows:

	Bundles
I. A_1 with 1 knot	2
A_2 with 2 knots	2
A_3 with 3 knots	2
II. B_1 with 1 knot	2
B_2 with 2 knots	2
B_3 with 3 knots	2
III. C_1 with 1 knot	2
C_2 with 2 knots	2
C_3 with 3 knots	2
IV. D_1 with 1 knot	2
D_2 with 2 knots	2
D_3 with 3 knots	2
V. E_1 with no knot	2
E_2 with no knot	2
E_3 with no knot	2

The prepared twines were immersed in their corresponding coal tar solutions A, B, and C and in the imported ready-made coal tar D. The twines were immersed for five minutes and the excess solution removed by evenly pressing the bundles with the hands; then they were hung and dried in the shade with free-circulating air. After four hours all the treated twines were completely dried. The increase in weight after treatment was determined.

The experiment was divided into three parts, according to the nature of exposure, as follows:

1. Weathering.
2. Continuous immersion in the sea and brackish water.
3. Intermittent immersion in sea and brackish water.

The schedule of exposure and sampling was as follows:

(*a*) *Weathering.*—One portion consisting of five bundles (A, B, C, D and E) was exposed to the atmospheric weather, and sampling was done once a week.

(*b*) *Continuous immersion.*—Same number of bundles as in (*a*). The bundles were continuously immersed in sea and in brackish water. Sampling was once a week.

(*c*) *Intermittent immersion.*—The schedule of immersion was as follows:

1. Saturday, 8:00 A.M.	Immersion.
2. Monday, 4:00 P.M.	Removal from the water and hanging to dry.
3. Tuesday, 8:00 A.M.	Immersion.
4. Thursday, 8:00 A.M.	Removal from the water and hanging to dry.
5. Friday, 8:00 A.M.	Sampling and immersion.
6. Monday, 4:00 P.M.	Repeat as of last week.

In sampling, five twines were removed from each bundle, then washed thoroughly with fresh water and dried.

RESULTS AND DISCUSSIONS

The intensity of color and the amount of coal tar deposited in the twine varied according to the density of the prepared coal tar solutions; that is, the higher the percentage of coal tar, the higher was the percentage increase in the weight of the treated twines (Table 1). Table 1 shows also that dilution B and the imported texaspaltic net drip, designated as D, yielded practically the same average increase in weight.

Intermittent submersion.—Table 2 shows the actual breaking strain of the treated twines submerged in sea and brackish water. Twines A, B and C, in brackish water, lasted 91 days; D, 98 days, and the control E, 70 days. On the other hand, in the sea, A, B and C lasted 70 days; D, 84 days and the control E, 56 days. The results of the experiment proved that coal tar shows protective quality against deterioration of twines submerged continuously or intermittently in the sea or

TABLE 1.—*Increase in weight of the twine after treatment with various dilutions of coal tar.*

Dilutions	Weight of twine		Increase in weight		
	Before treatment	After treatment	Grams	Per cent	Average
	gm	*gm*			
A-1	146.3	220.0	73.7	50.37	
A-2	144.7	218.5	73.8	51.00	
A-3	144.5	215.5	71.0	49.13	50.67
B-1	131.4	186.0	54.6	41.55	
B-2	145.5	221.0	75.5	51.88	
B-3	151.0	216.5	65.5	43.37	45.27
C-1	142.0	202.5	60.50	42.60	
C-2	144.5	207.5	63.00	43.59	
C-3	129.6	181.0	51.40	39.66	41.95
D-1	145.6	211.0	65.40	44.91	
D-2	143.3	210.0	66.70	46.54	
D-3	144.5	212.5	68.00	47.06	46.17
E-1	151.1				
E-2	162.0				
E-3	152.5				

in brackish water. It is likewise evident that the imported coal tar solution D, containing rosin in addition to the antiseptic compounds inherently present in coal tar, exhibits higher preserving quality than coal tar alone. More experiments along this line should be continued in order to get more conclusive results.

TABLE 2.—*Comparative average actual breaking strain in kilos of cotton twines exposed intermittently in brackish and sea waters.*

Number of days exposed	Brackish water				
	A	B	C	D	E
	9.30	8.18	7.86	8.96	11.44
7	7.80	8.60	8.90	11.50	10.42
14	8.08	8.50	8.30	11.30	9.38
21	8.26	8.70	7.40	13.52	9.28
28	8.06	7.96	7.26	11.70	7.00
35	6.90	6.02	5.40	11.20	4.84
42	5.90	6.19	5.02	9.98	4.00
49	6.37	5.18	4.55	8.96	2.68
56	6.10	5.68	4.85	9.60	0.61
63	4.15	4.05	5.20	6.80	0.58
70	4.10	3.70	2.20	6.70	0.31
77	3.76	3.50	2.18	4.48	
84	2.86	2.03	1.93	3.43	
91	1.52	1.02	.04	2.04	
98				1.04	
105					

TABLE 2.—*Comparative average actual breaking strain in kilos of cotton twines exposed intermittently in brackish and sea waters.—(Cont.)*

Number of days exposed	Sea water				
	A	B	C	D	E
0	9.30	8.18	7.86	8.96	11.44
7	9.64	8.54	8.20	9.30	8.86
14	8.15	7.50	7.35	10.01	7.88
21	7.75	7.75	7.03	9.50	6.48
28	6.63	6.15	5.60	8.45	4.48
35	6.31	6.44	5.90	8.00	3.05
42	6.54	5.31	4.68	7.20	2.40
49	5.11	4.53	3.96	6.28	1.43
56	4.48	3.84	3.98	5.24	1.78
63	2.45	1.07	1.15	3.05	----
70	0.93	0.42	0.09	2.04	----
77	----	----	----	1.62	----
84	----	----	----	----	----
91	----	----	----	----	----
98	----	----	----	----	----
105	----	----	----	----	----

Intermittent submersion of the twines proved that deterioration is faster in the sea than in brackish water (Table 2). However, Farrar (1950) claimed that during summertime, net deterioration is faster in brackish water than in sea water. His claim holds true when the treated twines are continuously submerged, as reported in Table 3, which reveals that on the

TABLE 3.—*Comparative average actual breaking strain in kilos of cotton twines exposed continuously in brackish and sea waters.*

Number of days exposed	Brackish water				
	A	B	C	D	E
0	9.30	8.18	7.86	8.96	11.44
7	9.20	8.80	8.40	9.40	10.40
14	7.52	7.46	6.18	9.36	7.58
21	5.28	4.20	6.06	10.22	5.06
28	2.46	3.54	5.50	11.04	3.52
35	0.50	1.88	2.24	10.96	0.76
42	0.41	----	0.84	7.00	----
49	0.40	----	0.36	7.00	----
56	----	----	----	2.90	----
63	----	----	----	2.44	----
70	----	----	----	1.92	----
77	----	----	----	1.54	----
84	----	----	----	0.91	----

Number of days exposed	Sea water				
	A	B	C	D	E
0	9.30	8.18	7.86	8.96	11.44
7	9.10	9.34	8.50	11.36	9.56
14	7.25	7.36	6.43	9.36	7.38
21	7.75	7.75	7.03	8.45	6.48
28	6.63	6.15	5.60	9.50	4.48
35	1.93	1.41	0.81	8.12	0.94
42	0.93	1.05	0.93	6.26	----
49	----	----	0.06	2.80	----
56	----	----	----	1.86	----
63	----	----	----	----	----
70	----	----	----	----	----
77	----	----	----	----	----
84	----	----	----	----	----

TABLE 4.—*Average actual breaking strain in kilos of cotton twines exposed to atmospheric weather.*

Number of days exposed	A	B	C	D	E
0	9.30	8.18	7.86	8.96	11.44
7	8.04	7.42	7.94	8.08	9.22
14	9.74	9.60	10.44	9.44	11.01
21	8.62	8.15	9.16	9.02	10.10
28	8.33	7.31	7.85	8.71	8.43
35	7.91	7.48	7.83	8.30	8.10
42	7.90	7.60	8.28	8.30	7.70
49	7.80	6.92	7.79	8.20	7.30
56	6.65	7.61	8.03	7.93	6.63
63	7.51	6.18	7.33	7.85	6.41
70	7.00	6.16	6.41	7.00	6.28

28th day after continuous submersion, those in the sea demonstrated higher breaking strain than those in brackish water, but the continuous striking of the waves against the twines resulted in the abrupt lowering of the breaking strain, thereby deteriorating the twines submerged in the sea in a very much shorter time.

Continuous submersion.—The result of the experiments of the twines continuously immersed in brackish water and in the sea corroborates the claim of Farrar (1950) that deterioration is faster in brackish water than in sea water. It proved that the imported coal tar D, containing a certain percentage of rosin, preserved the twines longer, whether such twines were submerged intermittently or continuously in brackish water or in the sea.

The twines exposed to the atmospheric weather deteriorated gradually. On the 77th day, the twines A, B, C, D, and E showed definite deterioration, although bacterial action was less due to drying. However, the treated twines A, B, C, and D seemed to have little resistance to weathering as compared to the control E which gave the lowest breaking strain.

The experiments on gear preservatives conducted by Clague and Datingaling (1950), used pure pine tar and pine tar with creosote which proved to be two of the most effective net preservatives. These preservatives, however, do not seem to be suitable for use in the Philippines, because the tropical climate renders the gear messy and consequently inconvenient to handle. But the use of coal tar properly diluted with a quick drying organic compound renders the net impervious to water, which condition enhances rapid drying even in the shade with a continuous draft. The increase in weight was reduced

from almost 100 per cent in the case of pure tar, to only about 50 per cent when properly diluted.

The extension work conducted by Mr. Gonzalo Ferrer, Gear Technologist of the Bureau of Fisheries, revealed that the use of a diluted coal-tar net preservative proved very successful in the Visayan Islands. According to him, there were cases when the otter trawl net was used continuously for six months without retreatment. When tan bark was used, retreatment was done twice a week which made the use of this common native net preservative impractical and uneconomical. The result of this experiment proved that the use of diluted coal tar protects the twines from deterioration, whether they are immersed intermittently or continuously, or exposed to atmospheric weather.

SUMMARY

The use of coal tar as a net preservative was reviewed. The fact that pure or undiluted coal tar is not practicable to use as a net preservative under the Philippine tropical climate, three dilutions of coal tar were prepared using gasoline as a diluent.

The experiment proved that coal tar diluted with gasoline preserved cotton twines (figs. 1–5) when submerged continuously or intermittently in both brackish and sea water.

Diluted coal tar with rosin as exemplified by the imported coal-tar net preservative D, has higher preserving qualities than any of the other pure coal tar dilutions (figs. 1–5).

In the absence of the imported ready-made coal-tar net preservative D, pure coal tar diluted with gasoline would serve well as a preservative for dragging nets under Philippine climatic conditions. Because diluted coal tar impregnates the cotton fibers instantaneously without the aid of heat, it eliminates the usual fire hazard and the tremendous increase in weight. Coal tar renders the cotton fibers impervious to water, which makes drying quick, even when the net is hung in the shade with continuous air circulation.

In one of the demonstration trips in the Visayas, a fisherman, using an otter trawl net preserved in diluted coal tar, managed to fish continuously for six months under very unfavorable weather conditions without retreating his net. The use of diluted coal tar as a net preservative is now very popular in the Visayas.

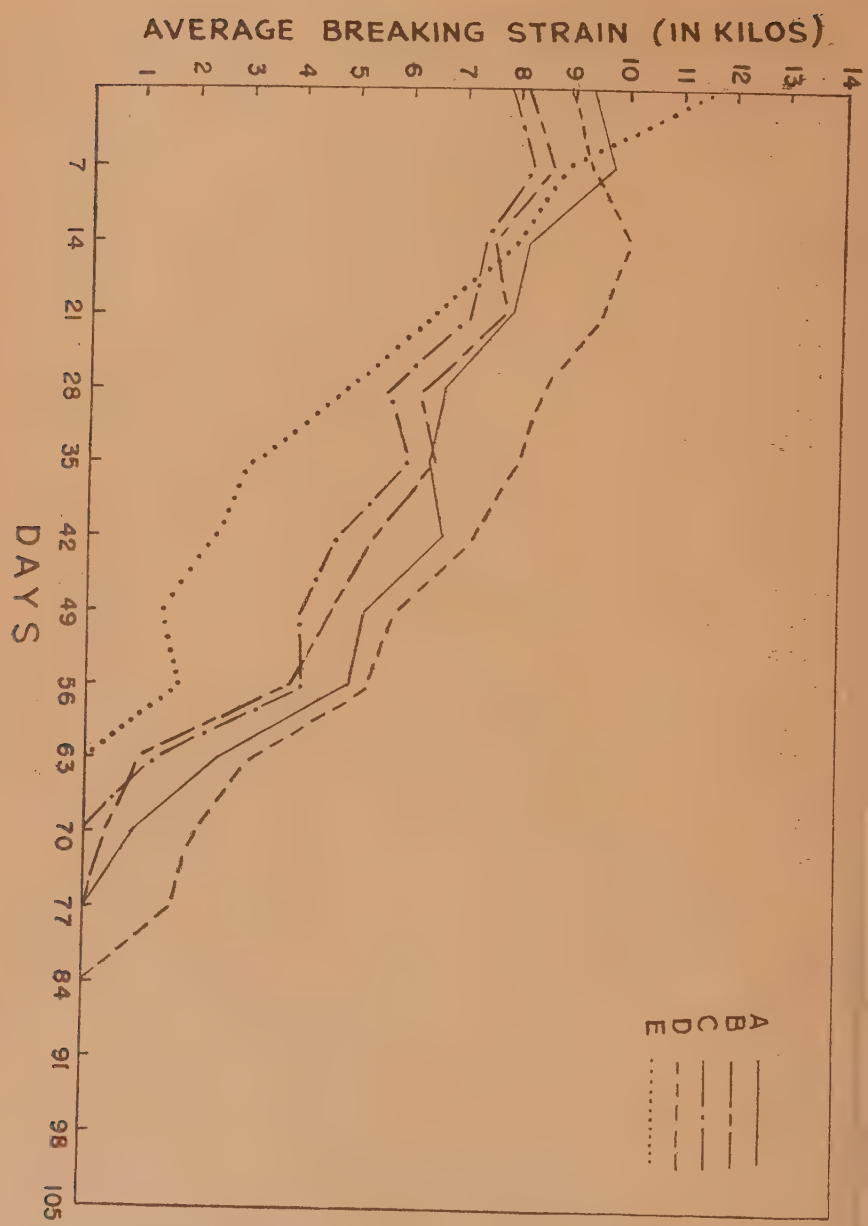

FIG. 1. Average actual breaking strain in kilos of cotton twines submerged intermittently in sea water.

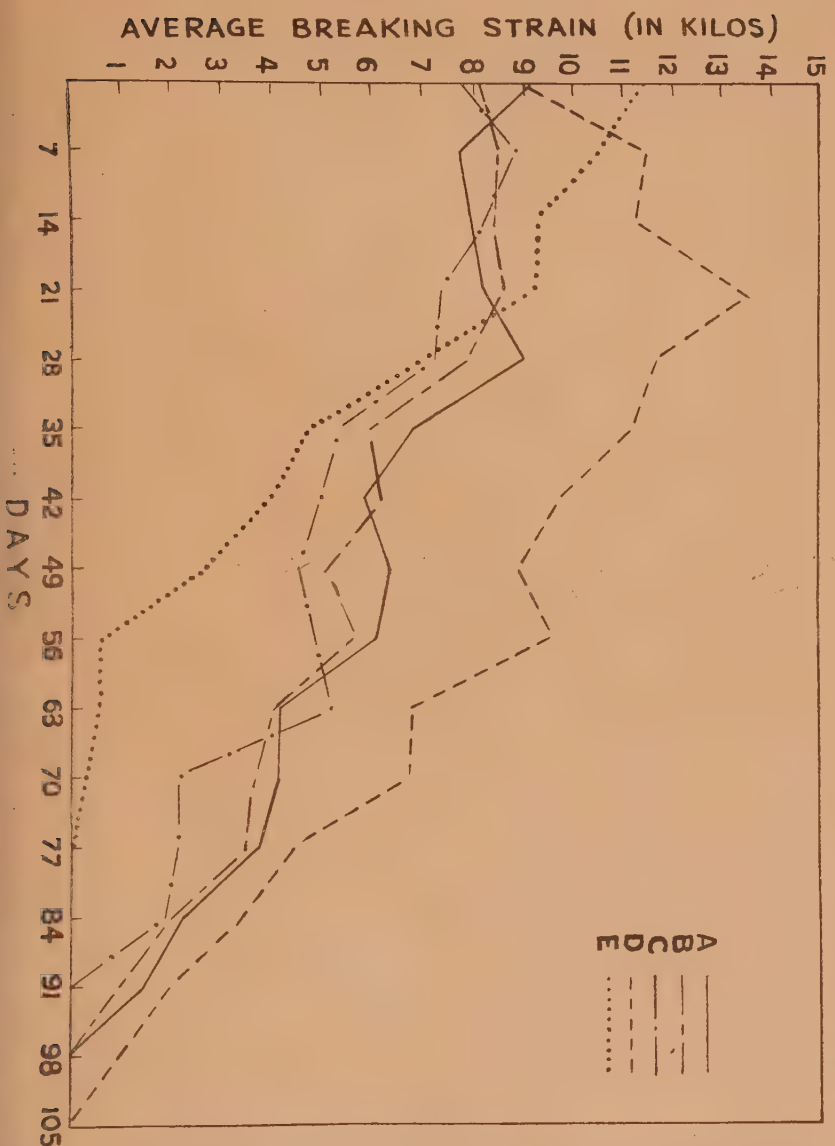

FIG. 2. Average actual breaking strain in kilos of cotton twines submerged intermittently in brackish water.

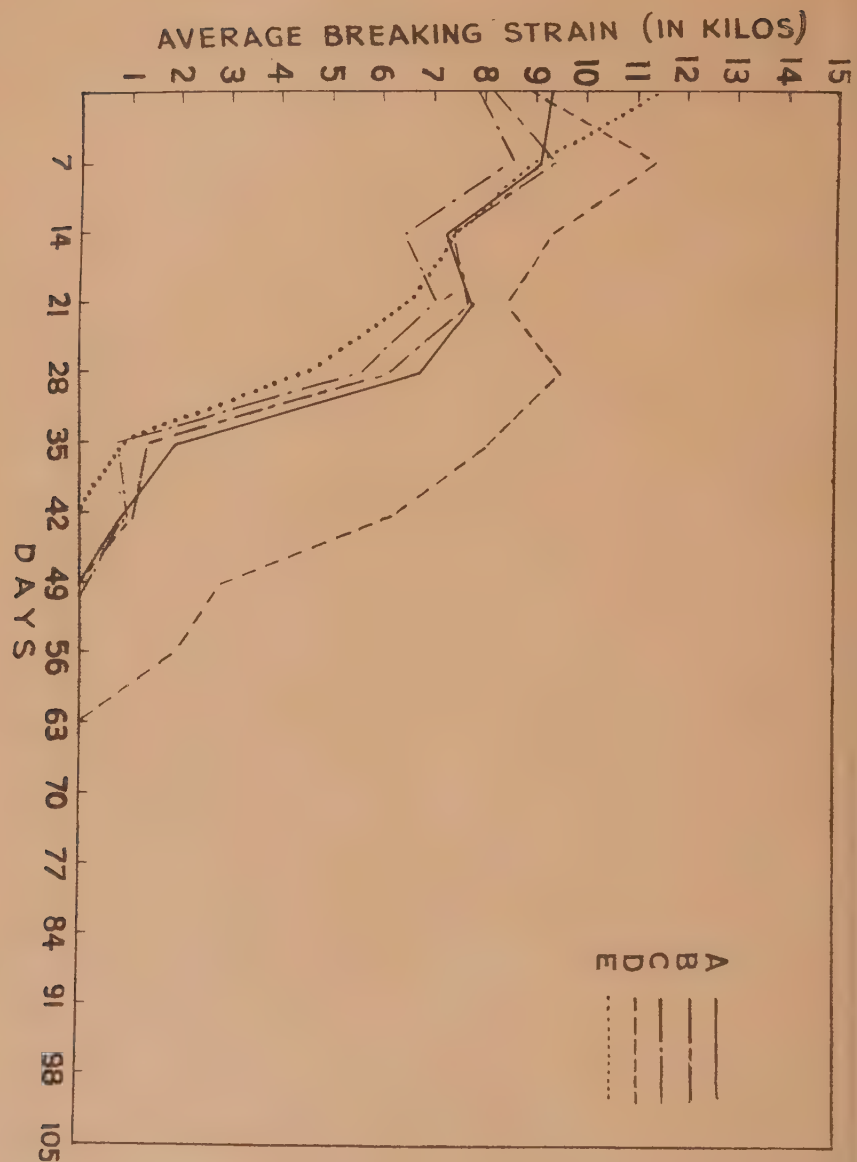

FIG. 3. Average actual breaking strain in kilos of cotton twines submerged continuously in sea water.

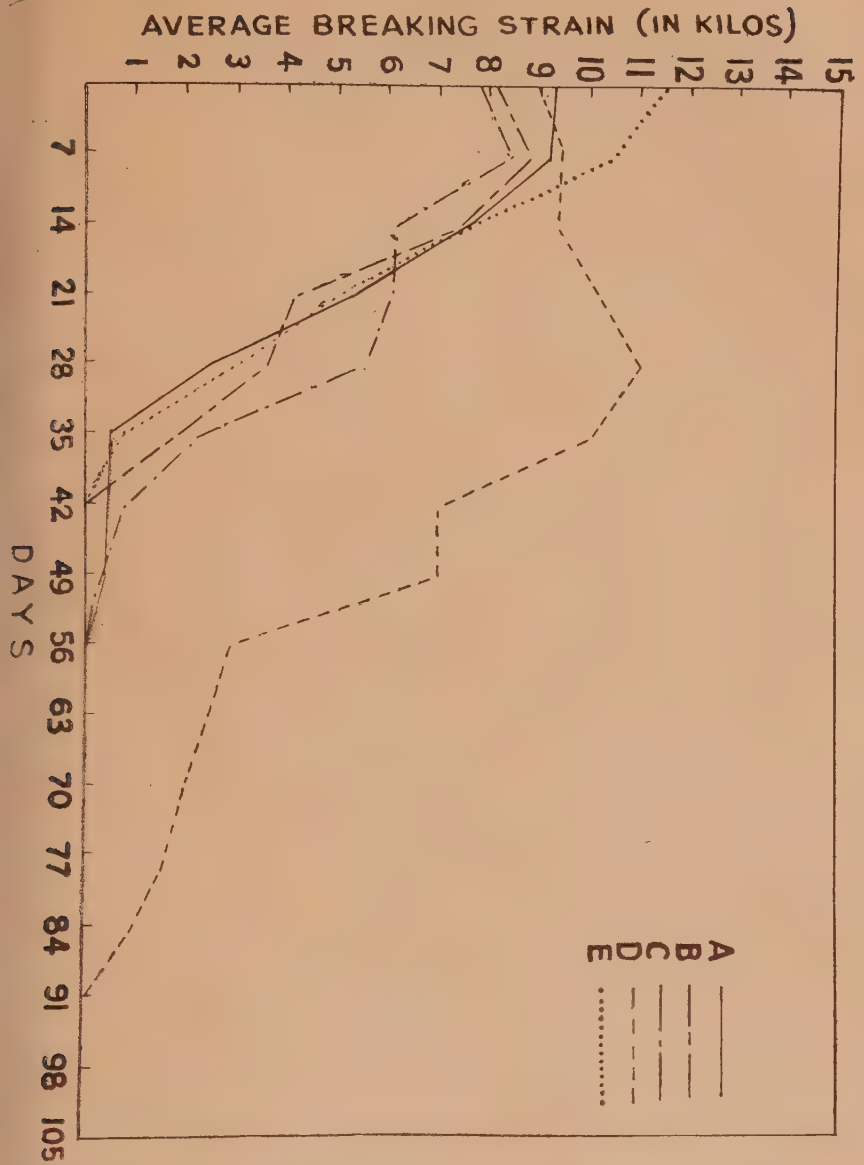

FIG. 4. Average actual breaking strain in kilos of cotton twines submerged continuously in brackish water.

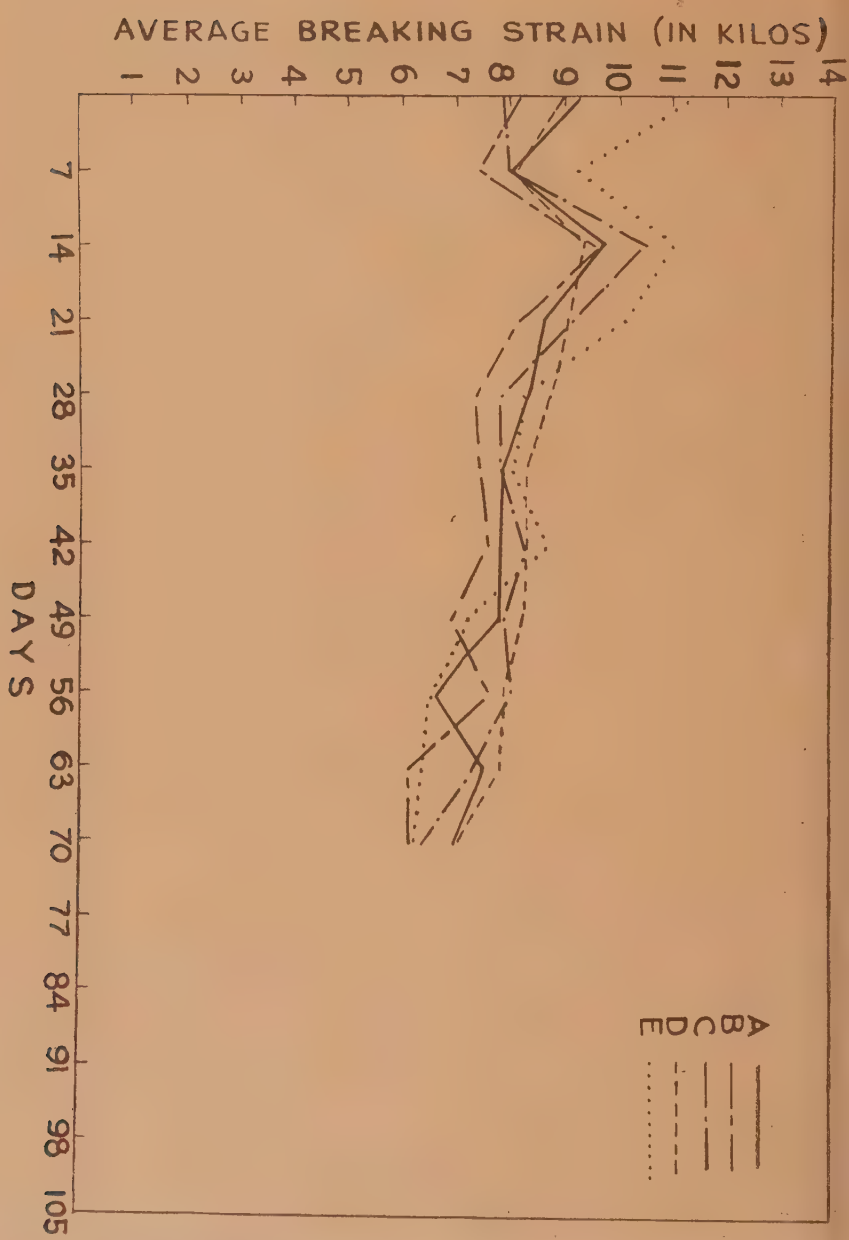

FIG. 5. Average actual breaking strain in kilos of cotton twines exposed in the atmospheric weather.

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ILLUSTRATIONS

TEXT FIGURES

FIG. 1. Average actual breaking strain in kilos of cotton twines submerged intermittently in sea water.
2. Average actual breaking strain in kilos of cotton twines submerged intermittently in brackish water.
3. Average actual breaking strain in kilos of cotton twines submerged continuously in sea water.
4. Average actual breaking strain in kilos of cotton twines submerged continuously in brackish water.
5. Average actual breaking strain in kilos of cotton twines exposed in the atmospheric weather.

TWO PHILIPPINE BORING MOLLUSCS

By GUILLERMO L. ABLAN
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ONE PLATE

Pholads are known to attack rocks of various kinds by tunnelling or rasping holes in similar manner as teredo does in wood. Among rock borers, *Parapholas concamerita* Desh., is reported to occur and to be fairly common on the rocky coasts of the Philippines. This species measures 3 inches or more in length. Ablan (1938) noted *Pholas orientales* Gmelin living in colonies, burrowing in the sandy mud in Pontevedra, Negros Occidental. Many of this species were removed from the soil 9 to 22 inches deep.

Among molluscan borers the teredo is the most destructive wormlike bivalve. Its shells at one end are reduced to a pair of hard chisels which are moved up and down by powerful muscles with which to excavate its burrow in the wood. Its stomach secretes a digestive ferment which converts some of the wood into sugars. The teredo is considered to be one of the few highly organized animals capable of digesting wood fiber. It is the only boring animal in the sea dependent for food and shelter on the material which it bores and is so highly especialized that it can only begin a burrow at a very early stage of its existence. If an adult teredo is dislodged from its burrow, it cannot make a new one but dies helplessly.

The writer, on October 15, 1948, came across a floating piece of worn-out piece of wood (*Avicennia officinalis* Linnæus) measuring about a meter long and 15 centimeters in diameter badly tunnelled on the surface and drifted ashore by the tide in the Provincial Demonstration Oyster Farm at Manat, Binmaley, Pangasinan Province. Splitting the wood with a hatchet, he dislodged and saved for study two species of molluscs embedded in large number in the wood. The two species are of the genera *Gastrochaena* and *Barnea* of the family Pholadidæ. At present it is not known with certainty as to whether a certain species of the genera is specific to the kind of surface and nature of wood it attacks. *Gastrochaena rostrata* Speng., one of the species here described, attacks readily bamboo [*Bambusa*

spinosa Roxb. (Gram)] splits which are usually employed as oyster spat collectors and fish corrals. This borer also destroys spat collectors planted in oyster beds.

The attacked piece of wood is a mangrove species locally abundant along muddy seashores of Philippine tidal streams. Its ash is leached and the resulting liquor is an important ingredient in soap making. This particular wood is known locally as *kalapini, kalumpini* (Ilocos Norte, Pangasinan, Zambales); *mangitit* (Zambales); *bongalon* (Pangasinan, Polillo, Marinduque, Mindoro, Iloilo, Negros Occidental); *bungalin* (Pampanga); *api-api* (Bataan, Capiz, Mindoro, Masbate, Cotabato, Zamboanga); *api mavani* (Albay); *kuyapi* (Camarines); *pepisik* (Tayabas, Camarines); *miapi, piapi* (Tayabas, Samar, Leyte, Misamis); *kilassi* (Cotabato, Davao); *pundung* (Davao). Reyes (1933) characterizes this species of wood to have decidedly crossed grains which are irregularly wavy or twisted, slightly salty in taste, and perishable when exposed to weather or in contact with the ground.

DESCRIPTION OF SPECIES

BARNEA MANILENSES Phil. Plate 1, fig. 2.

Shell elongate and corncoblike, dull-white; anterior gradually bulging from posterior side; surface laminated with toothed clockwise ridges. Anterior tips sharp, anteventral margin toothed. Shell with an elongated and pointed shell piece. Inside shell surface whitish. Prominent spines present, one each below hinge of each valve. Open on both ends.

Measurement of Barnea manilensis Phil. in inches.

Sample number	Greatest thickness	Shell valves	
		Length	Width
1	3/4	2-3/16	3/4
2	5/8	2-5/16	3/4
3	11/16	2	3/8
4	7/8	2-7/8	3/4
5	3/4	1-7/8	3/4
6	11/16	2-1/16	5/8
7	11/16	2	5/8
8	7/8	2-3/8	3/8
9	5/8	1-15/16	5/8
10	3/4	2-9/16	3/4
11	11/16	2-1/8	11/16
12	11/16	2-1/8	11/16
13	5/8	2-1/8	5/8
14	3/4	2-1/4	11/16
15	5/8	2	5/8
16	5/8	1-13/16	5/8
17	5/8	1-7/8	5/8

The type specimen was collected in Manila and described as a fine white 2.5-inch shell which lives in burrows along the Philippine coasts. It is quite similar to other species of which there are a dozen or more in the genus.

GASTROCHAENA ROSTRATA Speng. Plate 1, fig. 4.

Shell irregular in shape, tapering posteriorly, bulkier and rounded anteriorly, well fitted with opening on both ends, crowned with a rounded shell piece. Fine undulating ridges present below crown. Prominent horizontal groove present on anterior of shell. Dull-white anteriorly, dull-yellow posteriorly. Interior of shell whitish. Under hinge a spine present on each valve.

These little borers are also common in the West Indies and can perform wonders with a good thick plank or post to work on. They will bore so many holes leaving only a skeleton of the object left which is easily crushed in your hands. There are three species on the east coast of the United States, from North Carolina southward. Some species bore in clay.

Measurement of Gastrochaena rostrata Speng. in inches.

Sample number	Greatest thickness	Shell valves	
		Length	Width
1	7/16	7/16	1/2
2	1/2	1-5/16	1/2
3	7/16	1-7/16	7/16
4	7/16	1-5/16	7/16
5	3/8	1-3/8	3/8
6	3/8	1-1/16	3/8
7	7/16	1-1/16	7/16
8	7/16	7/8	7/16
9	3/8	3/4	3/8
10	3/8	5/8	3/8

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ILLUSTRATIONS

Plate 1

Fig. 1. *Barnea manilensis.*

2. External and inside feature of shell of *Barnea manilensis.*

3. Surface of bamboo pieces attacked with *Gastrochaena rostrata.*

4. External and inside features of shell of *Gastrochaena rostrata.*

LATTICE METHOD OF OYSTER CULTURE

By Guillermo L. Ablan

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THREE PLATES

Oysters, owing to their high nutritive value and the various uses of their by-products, are the most important bivalves for cultivation. A number of local species suitable for culture are widely distributed throughout the country. Several coastal localities that are potential natural grounds for oysters are awaiting exploitation. They consist of bays, gulfs, lagoons, mouth of rivers, tidal streams, estuaries and inland seas. However, only limited areas in regions thickly populated around Manila Bay and Lingayen Gulf are utilized. There is a great demand for oysters free from pollution and contamination. The methods of culture in existing oyster farms are similar to those practiced abroad. While these methods have their own advantages depending on prevailing local conditions, an improved device adaptable for use in most places here is described in this paper.

Ablan (1949) considers bamboo (*Bambusa spinosa* Roxb.), abundant locally, an ideal material for farming oysters. Considerations for its choice are: Easy to procure, reasonably priced, fairly durable, its workable quality to suit any design or style of spat collecting device adaptable and practical to use on any type of bottom and on either horizontal or vertical plane.

In Japan several methods of oyster culture are employed to make use of every possible area or space available. Observations on these methods reveal that oysters grow faster near the surface where food is more abundant, temperature higher, and water less saline.

TABLE 1.—*Comparative data on age of marketable size of oysters.*

Culture		Locality	Age	
			Years	Months
Bottom	Broadcasting empty shells.	Japan	3	
Vertical	Pendant	----do----	1-1/2 to 2	
Bottom	(1)	Philippines	1 to 1-1/2	
Vertical	Staking	----do----	----------	6 to 10
Floatation	Lattice	----do----	----------	

DISCUSSION ON THE LATTICE METHOD OF OYSTER CULTURE

Staking method (usoc, tulus, or darecdec) made out of bamboo trunk splits is employed in Binakayan, Cavite Province; San Fabian, Dagupan and Binmaley, Pangasinan Province; Carlatan Lagoon, San Fernando, La Union Province; and Abucay, Bataan Province. Repeated use of this method causes several difficulties. Hard sandy bottom requires much effort in staking bamboo trunk splits and if these are not stuck firm enough into the sandy soil they are uprooted due to wave action and practically lost. Seeded bamboo trunk splits with oysters cannot support the weight of growing oysters causing them to break. Portion of the stake buried in the soil does not produce any oyster. Harvesting oysters from stakes needs double effort to collect them. To minimize this difficulty, bamboo trunk splits are woven into lattice. Galvanized wire No. 14 is used as a tying material. The splits are spaced from 6 to 12 inches. On the average, a lattice varies from 10 to 16 splits and can easily be handled by an individual.

Bamboo lattice on a horizontal plane consists of the following methods:

1. Fence style, either stuck on the bottom or supported with bamboo trunk posts.
2. Tent formation in rows.
3. Lattice of several pieces can be mounted in racks set either singly or in layers.
4. Lattice with support can be laid on the bottom.

METHODS ON A VERTICAL PLANE

1. Floatation method—Lattice mounted on long bamboos and are reinforced with empty drums.
2. Suspension method—Three pieces of lattice assembled in a triangular form supported with long bamboos and empty drums.
3. Combination method—Floatation and suspension method using strings of empty shells.

ADVANTAGES OF BAMBOO LATTICE

1. A device usable singly or in a multiple series in either vertical or horizontal plane.
2. Eliminates losses of spat collectors and can support weight of growing oysters.
3. A labor-saving device for their layout and harvesting oysters.

4. Oysters raised do not touch the bottom and are protected from bottom enemies.

5. Practical for collecting, growing and fattening oysters.

6. Increases production not only per unit area of ground but in a three dimensional space.

7. Growth of oysters can be accelerated by placing them to suitable water level where food is abundant, temperature favorably high, and water is less saline.

Only four out of 23 species of oysters reported in the Philippines are of commercial importance. *Ostrea iredalei* Faustino, *Ostrea malabonensis* Faustino and *Ostrea palmipes* Sowerby are cultivated. *Ostrea cucullata* Born, growing wild in quantity on the rocky bottoms of Catbalogan, Samar Province, the center of salted "sisi" industry, is also of commercial importance. *Ostrea iredalei* Faustino is the most important as to size and quality. *Ostrea malabonensis* Faustino ranks second and *Ostrea palmipes* Sowerby comes third.

Orton (1937) graphically showed that *Ostrea edulis,* 1½ years old and about an inch in size, gives a 2½ cubic centimeters of meat as compared with the meat of Philippine oysters about 4 months old.

Oysters about 4 months old were raised on floated bamboo lattice set on December 1, 1949 and examined on March 23, 1950. They were detached for measurement of the size and volume of meat and the results are shown in the following table.

TABLE 2.—*Size and volume of meat of cultivated oysters about 4 months old by the lattice method.*

Species	Specimen examined	Average measurement of left valve in inches		Average measurement of meat in inches		Average volume of meat in cc.
		Length	Width	Length	Width	
Ostrea iredalei	25	2-1/4	1-1/4 to 2-1/2	1-1/8 to 2	3-4 to 1-1/2	4 to 7
Do	8	2-3/4	1-1/4 to 2-1/2	1-3/8 to 2	1 to 1-1/4	4 to 6.5
Do	3	3-1/4	1-1/8 to 2-3/8	1-3/4 to 2-1/4	1	5 to 6
Ostrea malabonesis	9	1-1/4 to 1-3/4	7/8 to 1-3/8	1 to 1-1/2	1/2 to 9/16	1 to 3
Do	9	2 to 2-1/4	1-1/4 to 1-3/4	1 to 1-1/2	7/8 to 1-3/8	1 to 3
Ostrea palmipes	20	1 to 2	7/8 to 1-1/2	3/4 to 1-1/4	1/2 to 7/8	1 to 2.5

REMARKS AND RECOMMENDATIONS

Oyster farming offers a lucrative venture in the Philippines as shown in the following:

1. Remarkable rate of growth.
2. Availability of extensive and potential grounds for oyster cultivation.
3. Presence of commercial species ready for exploitation.
4. Increasing demand for them as food and the various uses of their by-products.
5. Procurability of cheap materials for farming them.
6. Reasonable cost of labor prevailing and high yielding capacity of per unit area of space.

As a government agency, the Bureau of Fisheries should be given more appropriations for extension work on oyster culture. With sufficient funds available a well organized extension service may be established to undertake the establishment and supervision of more oyster farms for demonstration purposes, to make necessary survey of all potential oyster grounds in the country and to make a working program of developing them.

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ILLUSTRATIONS

Plate 1

Diagrammatic sketches of the lattice method.

Plate 2

Fig. 1. Provincial Demonstration Oyster Farm House-Office and Laboratory.
2. Concrete ladder leading to Oyster Farm House.
3. Strings of oyster from lattice.
4. Bamboo lattice.
5. Bamboo lattice laid out in tent style.
6. Supporting weight of bamboo lattice laid out in tent style.
7. Side view of bamboo lattice laid out in tent style.
8. Several bamboo lattice in layers.

Plate 3

Fig. 1. Bamboo lattice with strings of empty shells to collect oyster spats.
2. Three pieces of lattice in a triangular formation.
3. Floating bamboo lattice.
4. Floating bamboo lattice mounted to empty drums.
5. Seeded lattice tent formation.
6. Seeded lattice in layers.
7. Underside view of floated lattice with oysters.
8. Side view of floated lattice with oysters.
9. Strings of oysters in loop suspended from lattice.

NOTES AND OBSERVATIONS ON THE DANISH DEEP-SEA EXPEDITION OF THE "GALATHEA" TO THE MINDANAO DEEP

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OBJECTIVES OF THE EXPEDITION

The Danish research ship pulled into the port of Manila on July 6, 1951, and four days later it steamed away on its scientific mission to the Mindanao Deep. Among the most outstanding objectives of the Expedition to the Mindanao Deep were: To gauge by sounding the much disputed depth of the trench trawl for deep-sea animals and fishes, find how far below the surface living things can exist, determine the bottom configuration of the Deep, take bottom mud samples for bacteriological and sedimentation studies, and make organic productivity measurements. Last but not least was the spreading of Danish goodwill, wherever the work of the Expedition took the ship in its two-year round-the-world cruise of scientific discoveries.

THE BOAT AND ITS PERSONNEL

Constructed in 1933, the corvette "Galathea" had a war record of many years. Until it was commissioned for its oceanographic mission round the world, the ship plied between Denmark and England as a tourist ship. With a tonnage of 1,630 tons, it had a length of 79.9 meters and a draft of three meters. With a cruising speed of 12 knots, it was equipped with an automatic pilot and a Decca radar. Its twin-propeller drive, a feature little exploited by research ships in general, multiplied manifold the maneuverability of the boat which was of great help in hove-to operations.

Manned by a staff of 10 officers and a crew of 79, the "Galathea" carried 17 scientists in addition to a number of foreign scientists who came on and off in the course of her cruise round the world. The ship was under the command of Capt. Svend Greve and the Expedition under the leadership of Dr. Anton F. Bruun, an expert on flying fishes and one of

the leading ichthyologists of the world. Dr. Torsten Gisler of the University of Lund, Sweden; Dr. Claude E. ZoBell of the Scripps Institution of Oceanography and the authors of these observations were among the foreign scientists, who joined the trip to the Mindanao Deep.

EQUIPMENT AND INSTRUMENTS

The most important equipment of the oceanographic vessel was the Hughes Recording Echo Sounder which in reality was the nerve center of all the boat's operations. The basic principles of the sounding machine revolved around the sending out of sound impulses from the bottom of the ship, measuring the time required for the resulting echo to return from the sea bed, and presenting the measurements in the form of a continuous graphical record of depth of water. The return of spurious echoes was reduced to a minimum by having the sound waves focused into a concentrated beam by a funnellike reflector, which projected the beam toward the sea bed. Soft bottom, air bubbles coming from the wake of the boat and creeping into the hydrophones, and the pitch and roll of the boat due to swells were the most important interfering factors, which introduced uncertainties in some of the recorded soundings.

The other important equipment used for deep-sea operations were the heavy dredge and hydrographic winches with tapered wires exceeding 12 kilometers in length. Both wire ropes contained a central core of hemp steeped in pitch. When payed out under load the wire stretched, thereby squeezing out the grease which under great pressures at ice-box temperatures congealed to form a thick coating of viscous material clinging around the wire. When a messenger was released to reverse the bottle clamped to the hydrographic wire, the speed of descent was greatly reduced by the clinging grease and by the progressive increase in viscosity of the successive layers of water, due to decreasing temperature and increasing pressure. Consequently, at the time the messenger hit the bottle, the force of impact was not sufficient to trip the mechanism that reversed the bottle. Seven successive failures in water sampling were believed due to such difficulty.

The dredges and trawls were of different types and sizes. A variety of types of trawl constituted the bulk of collecting gear. These were the sledge trawl, lobster trawl, shrimp and herring otter trawl, and the general purpose triangular otter

trawl. Most of the trawls had simple rectangular iron frames to which the collecting nets were attached. The nets tapered to collapsible cod ends, which were made of heavy canvass and supported by a pair of iron rings distanced a few inches apart. The dredges were smaller and had serrated iron frames.

The bottles, used for securing water samples, were of the modified Nansen type whose valves, when closed, sat on rubber gaskets. Heavily plated, each bottle carried a one-piece frame which housed the two deep-sea reversing thermometers. A number of the thermometers resisted pressure exceeding 1,000 atmospheres, while the others collapsed under those pressures. A number of the Watanabe (Japanese) thermometers of the Bureau of Fisheries tested during the trip withstood a pressure of 815 atmospheres.

For examining minute specimens, they had a special research microscope, whose construction was radically different from those in general use. The arm was at the front to give free access to the object, stage, objectives, substage and mirror, thus offering greater comfort and convenience to the user. The optical elements were Balcoted to avoid objectionable reflections which might interfere with the instrument in producing a sharper, clearer image most truly interpretive of the tonal characteristics of the specimen.

It is worthy to note at this point, that all the specimens collected were separated into phylogenetic groups soon after they were killed and then preserved and labelled accordingly. This was the first time that such practice was adopted in a long-range biological expedition.

ACHIEVEMENTS AND DISCOVERIES

In fulfillment of its first objective, the "Galathea" on July 29, 1951, at about 0024 hours, sounded a depth of 10,628 meters some distance away from the Snellius Deep, located approximately at 9° 42′ N and 126° 51′ E. It is interesting to compare it with soundings taken by other research vessels in previous years. The following table is a list of such soundings.

Nationality	Vessel	Year	Depth in meters
German	Planet	1912	9,789
German	Emden	1927	10,791
Dutch	Snellius	1930	10,160
American	Cape Johnson	1945	10,498
Danish	Galathea	1951	10,628

The Emden figure of 10,791 meters was the result of a spurious return signal, and therefore could not be accepted as a valid sounding (Hess and Buell, 1950). The sounding was made on a traverse nearly parallel to the axis of the trench using a non-directional echo sounder. In the sounding of the Japan Trench, a depth of 10,907 meters was recorded by the U. S. S. "Ramapo", using an audible frequency echo sounder. Hess and Buell re-analyzed the "Ramapo" data and found the maximum depth of only 9,803 meters. Allowing an error of 110 meters due to the average error in reading the echo sounder, deviation in frequency of the power current and error in the correction tables due to variations in the velocity of sound in water of varying degrees of temperature, salinity and pressure, the "Galathea" figure of 10,628 meters remains to be one of the deepest soundings ever made to-date. If the original figure is finally accepted, its corrected value thus estimated, leaves the Mindanao Deep in the same position of eminence as before, namely, that of being one of the deepest spots in all oceans.

The first attempt of the "Galathea" to trawl and dredge the narrow sea bed of the Mindanao Deep yielded results which occasioned a flood of congratulatory messages from people in Europe, who kept themselves posted with the activities of the ship. On July 21, 1951, at about 1845 hours the trawl with the two dredges brought up animal life from a depth exceeding 10,000 meters, the deepest part of the combed area being 10,462 meters. Two lamellibranchs, which showed evidence of life when hauled aboard, eight actinians and several holothurians came up with the collecting gear to create biological history. Subsequent operations added several amphipods and tanaidarians which increased the total number of species collected from the area.

Following the collection of these deep-sea forms, there had been lively speculations on how the organisms came to settle upon the deep sea bed. Being sessile, these animals could not have been caught from anywhere else except from the bottom or the walls of the trench. It was difficult to believe, however, that the pieces of stones to which the organisms were found attached could have been scraped from the steep slopes and entrapped by the heavy collecting gear dragging at the rate of 1.5 to 2.0 knots. The wire was taut and parallel to the axis of the keel, and the boat methodically and patiently positioned directly over the trench while trawling. The presence of stones on the sea bed reveals, according to one of the "Galathea"

scientists, the results of recent seismic disturbances. The Mindanao Deep, being the epicenter of most of the earthquakes occurring in Eastern Visayas and Mindanao (Selga, 1931), must have a foundation that is geologically unstable. Consequently, some recent crustal displacements there might account for the peeling off from the steep slopes of the stones which, together with their load of sessile animals, rolled down to rest upon the soft stratum covering the sea floor. If this assumption is true, the animals collected indeed must have been able to adjust themselves to their new and unusual environment.

In the light of the work of the "Galathea" the concept of an azoic zone in the abyssal depths is now a thing of the past, although earlier, this has been dubiously disproved by the plankton collections taken from comparatively shallower depths using the self-closing Palumbo net.

That other forms of life do exist in the cold, disphotic and quiet waters of the Mindanao Deep was conclusively demonstrated by Dr. Claude E. ZoBell, one of the guest scientists aboard, who found viable bacteria from the deepest layer of water sampled. Collecting the samples under sterile conditions, the American microbiologist was able to culture them successfully under simulated *in situ* conditions. Most of the bacteria observed were rodlike in shape and of the nitrifying type. The presence of nitrifying bacteria in the water and mud samples indicates that the mineralization of organic matter occurs within the entire water column and in the layer of sediment immediately below it. This is considered significant, as more importance can now be ascribed to the known slow process of diffusion which returns the regenerated plant nutrients to the euphotic zone to maintain the tropho-dynamic equilibrium in the sea.

Mud samples were taken by the Pettersson grab and the Kullenberg core samplers. The only core sample collected was taken from a depth of 10,328 meters. The sample which was 75 cm. in length was preserved in a plastic glass tube for further study in Copenhagen. From the sample, they hope to find radioactive substances which may throw light on the rate of sedimentation. For isotope determination, several samples of bottom water were preserved in heat annealed glass ampules.

In collecting bottom samples and specimens, the Danish scientists were faced with the problem of determining just when the gear hit bottom. If more wire was payed out than

necessary, the excess length looped over and possibly fouled the gear and prevented it from functioning normally. As the damaged wire was hauled in to raise the gear, the sudden increase in the tension of the wire snapped it at its weakest point, thereby losing valuable equipment. The dynamometer, which recorded the varying tension on the wire, was of little use, as it failed to register easily the resulting slack in the wire when the gear touched bottom. This was due to the light weight of the gear compared with the weight of the wire out.

To meet this problem in future deep-sea operations, Dr. ZoBell hatched the idea of conducting glass ball breaking experiments. If a gear carried a glass ball which was made to explode when the gear hit bottom, the resulting sound could probably be heard in the hydrophone. Surprisingly, the experiments yielded results which, among other things, satisfactorily explained the crushing of several deep-sea reversing thermometers used in the hydrographic work. Of the 58 glass balls lowered at different times to depths ranging from 9,000 to 10,418 meters, 28 were broken, 22 water-filled and the rest unbroken. The discordant results taken from the balls lowered at the same level were attributed to the fact that the balls were not made of uniform quality. However, it should be noted that these glass balls withstood pressure at 6,000 meters in previous experiments.

The information gathered from these glass balls breaking experiments promises to be of outstanding importance in the design and use of deep-sea instruments. The American scientist explained the phenomenon of breaking by saying that the glass was compressed until it failed. When the ball finally broke, water must have rushed suddenly to fill the void space, thus creating a region of greatly reduced pressure in the vicinity of the broken ball. The accompanying equalization in hydrostatic head resulted in what he termed an implosion. The penetration of water into some of the unbroken balls was explained by saying that it might have been due to some molecular phenomenon of an astonishing kind.

In the light of these experiments Dr. ZoBell's theory of implosion appears to be the only valid explanation for the pulverization of the glass of which the thermometers were made. The effect of the implosion was manifested by the caving in of the metal frames which held the thermometers in position.

A new concept on the behavior of oceanographic gear at subsurface depths was evolved when a bathysphere was sent down with a load of instruments, and returned with a record of its movements while in suspension in a mobile medium. With an inside diameter of about 22 inches, the metal ball was divided into two hemispheres flanged tightly together by closely spaced stud bolts. An aluminum frame of approximately two feet in width and eight feet in length was clamped to the wire a few feet above the shackle that linked the upper hemisphere with the end of the wire. In spite of the frame, a rotation of about 270 turns was recorded in one trial. One wing of the frame was bent, while the other had its distal end sliced off as if a sharp heavy knife had cut it. A maximum vertical displacement of about a meter was recorded.

On the basis of the bathysphere data, it may now be assumed that oceanographic gear lowered to great depths by a steel wire, composed of twisted strands, behaves in a similar manner. Thus, the number of failures experienced by the "Galathea" in her deep-sea operations can be ascribed to this fact.

One important aspect of the work of the "Galathea", which will influence greatly fishery researches of the future, pertained to organic productivity measurements. Outstanding in the principles involved and of far-reaching significance in the assessment of the fertility of surface waters, organic productivity measurements appear to afford the only direct approach to a quantitative study of the food cycle in the sea. With the method of using an artificially radio-activated carbon as a tracer in organic productivity studies, oceanography comes close to the threshhold of being able to assess fish production in terms of available plant nutrients in sea water. Where before the routine analysis of dissolved nutrient salts in sea water merely gave an indirect index to the fertility of a given area, now a direct correlation exists between hydrographic and biological data.

REMARKS AND RECOMMENDATIONS

On the whole, the work of the "Galathea" may be regarded as the starting point in unraveling the mysteries shrouding the Mindanao Deep. A repeated survey of the area with a reasonable interval of time may yield information important to the understanding of the capricious climatic changes around us. Now unknown to anyone, it may be playing an important role in developing the oceanographically interesting pattern of

oceanic circulation in the Western Pacific. Given active sup port by the public, which in Denmark made possible th "Galathea" Expedition, a similar undertaking, sponsored b the Government, can add to our knowledge of the Mindana Deep, which lies sprawled just behind our backdoor.

At the behest of the writers, Dr. Bruun, head of the scientifi staff, gave his views on problems which he thought shoul engage the attention of marine investigators in the Philippines He specifically suggested the statistical study of importan fisheries however faulty the data might be in the beginning For the census of fish populations, tagging experiments shoul yield first-hand information on the state of our fisheries. Thi will ultimately lead into an understanding of conservatio problems.

He would recommend the establishment of a deep-sea re search laboratory preferably in a protected town in Surigao

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THE NEW HASANG MODERNO, A FISH CORRAL USED IN THE PHILIPPINE WATERS[1]

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TWELVE TEXT FIGURES

ABSTRACT

Of the many types of fish corrals used for catching fish in sheltered waters of the Philippines, the new *hasang moderno* which was developed and operated at Kalibo, Capiz, during the summer months of 1950, is considered to be the most effective. Like the other fish corrals, this gear consists of a series of enclosures with a leader, four wings, and three entrances or gates. It differs, however, from the other types in that the terminal pond is located at the same axis with the leader on the outer side of the semicircular enclosure which it superimposes. The multiple entrances, together with the leader and the series of enclosures, effectively prevent the escape of the fish which are intercepted.

The method of construction and operation of the new *hasang moderno* is described in this paper and is fully illustrated. Complete specifications of this gear are also discussed.

Fish corrals are guiding barriers which are set in different depths of sheltered waters to intercept fishes during their migration, impounding them into the collecting chamber where they are caught. They are constructed in various styles, ranging from a simple ambulatory pound, with or without a leader, to a more or less complicated structure consisting of a series of enclosures, gates, wings, and a leader which are so arranged as to effect an easy entrance but difficult exit for the intercepted fish.

Of all the fish corrals operated in the Philippines, the *hasang moderno* has been considered the most effective. Based on the description of Talavera and Montalban (1932), this fish corral (fig. 1) consists of three gates, *m, se,* and *s'e';* four wings, *w;* a leader, *l;* a series of four enclosures; a heart-shaped terminal pound, *tp,* constructed at the end of one of the arms of the semicircular enclosure, *si,* which is superimposed by a triangular compartment, *tc,* and a triangular forechamber, *fc,* called *hasang,* from which the name of the fish corral was

[1] Contribution of the Philippine Delegation to the Third Meeting of the I.P.F.C. at Madras, India, February 1–16, 1951.

derived. This fish corral has undergone improvement, with simpler design and construction giving rise to the new hasang moderno. This new hasang moderno was first operated in Kalibo, Capiz, from April 1, 1950 to October 15, 1950. The

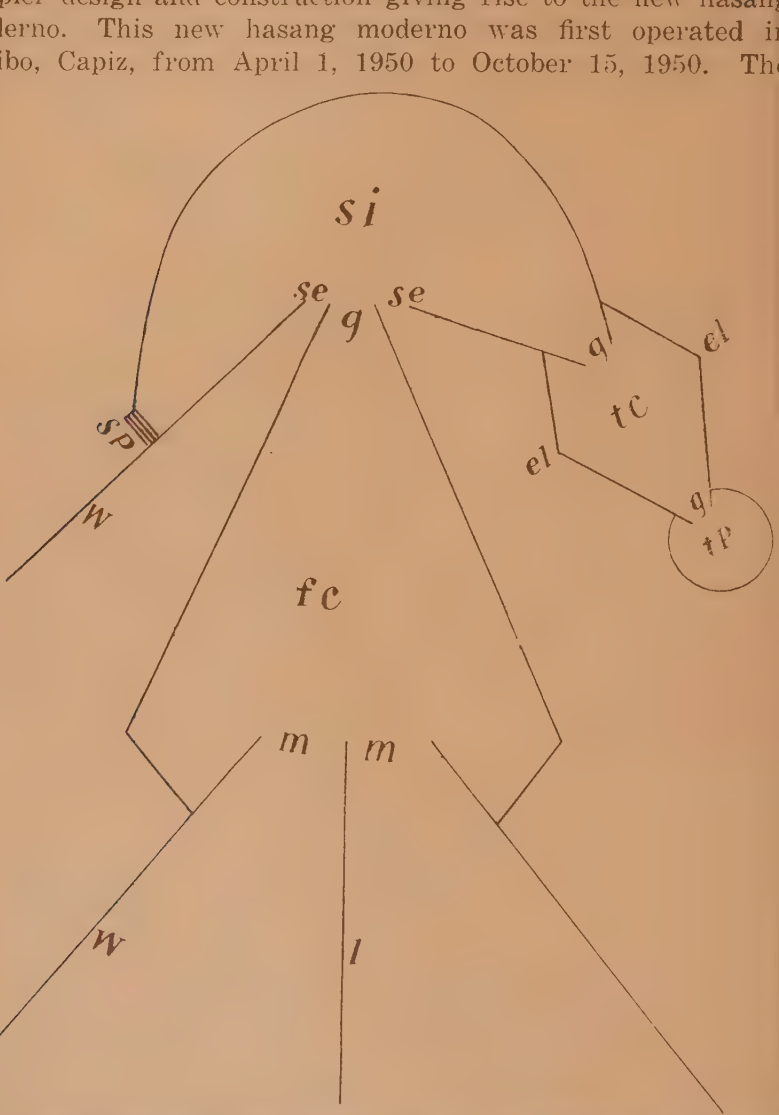
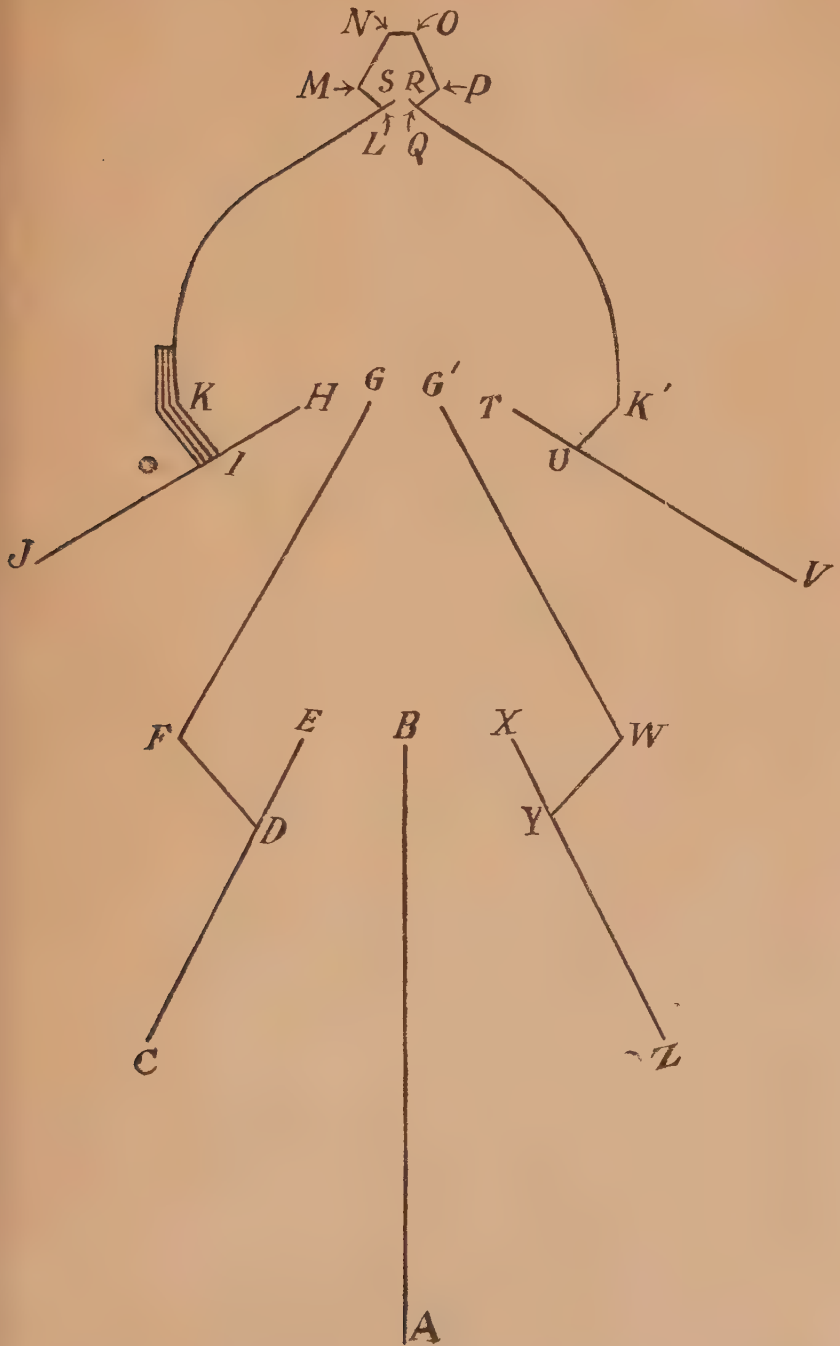


FIG. 1. Hasang moderno (1932) diagrammatic: *g*, entrance; *l*, leader; *m*, gate; *w*, wing; *el*, elbow; *fc*, forechamber; *se*, side gate; *si*, semicircular compartment; *tp*, terminal pound.

operation was very successful to the extent that it attracted the attention of other fish corral operators, living not only near that fishing ground, but also in other parts of the Philippines, who later on adopted its use.



2. The new hasang moderno: *AB*, leader; *CE* and *XZ*, lower wings; *JH* and *TV*, upper wings; *EX*, *GH*, and *G'T*, gate; *DFGG'WY*, forechamber; *IKSRK'UT*, semicircular enclosure; *LMNOPQ*, terminal pound.

This paper presents a detailed description of the construction and operation of this new type of gear.

GENERAL DESCRIPTION OF THE GEAR

Fig. 2 is the plan of the new hasang moderno. Like its prototype, it consists of a leader, *AB;* two lower wings, *CE* and *XZ;* two upper wings, *JH* and *TV;* three gates, *EX, GH, G'T;* a forechamber, *DFGG'WY;* a semicircular enclosure, *IKSRK'UT;* and a terminal pound, *LMNOPQ.* The terminal pound, however, is located at the same axis with the leader at the outer side of the semicircular enclosure which it directly superimposes.

Based on the new hasang moderno owned by Mr. Cirilo Lacerna Jr., a graduate of the Philippine Institute of Fisheries Technology, operated at Kalibo, Capiz, which may be taken as a typical sample of this fish corral, the measurements of the different parts are as follows:

The leader is 240 meters long and the lower and upper wings are 44 meters and 42.5 meters long, respectively; the forechamber is 44.60 meters at its greatest width, *FW,* and 31.55 meters long, measured from the lower gate to the entrance to the semicircular enclosure; the latter is also 44.5 meters wide, *KK',* and 26.9 meters long, measured from midpoints of *GG'* and *SR;* while the terminal pound is 8.9 meters wide, *MP,* and 8.2 meters long measured from the mouth of the semicircular enclosure *SR* to side *NO.*

The gear is invariably set in sheltered waters along sandy or muddy beds which are free from corral reefs. These waters are supposed to be across known paths of fishes ranging in depth from 5 to 12 fathoms. Usually waters which beds are higher than their immediate surroundings are preferred.

The fences of the fish corral consist of frames and bamboo screens. The frames (fig. 3) consist of well-seasoned bamboo posts and braces. The bases of the posts are pointed and triangular holes are bored just below the nodes for the water to fill in the internodes, thus making it easy to plant them at the muddy bottom.

The bamboo screens consist of bamboo splits laced together at regular intervals with either threaded coconut inflorescence bud scales, rattan (*Calamus* spp.) or *hagnaya* (*Polypodium*

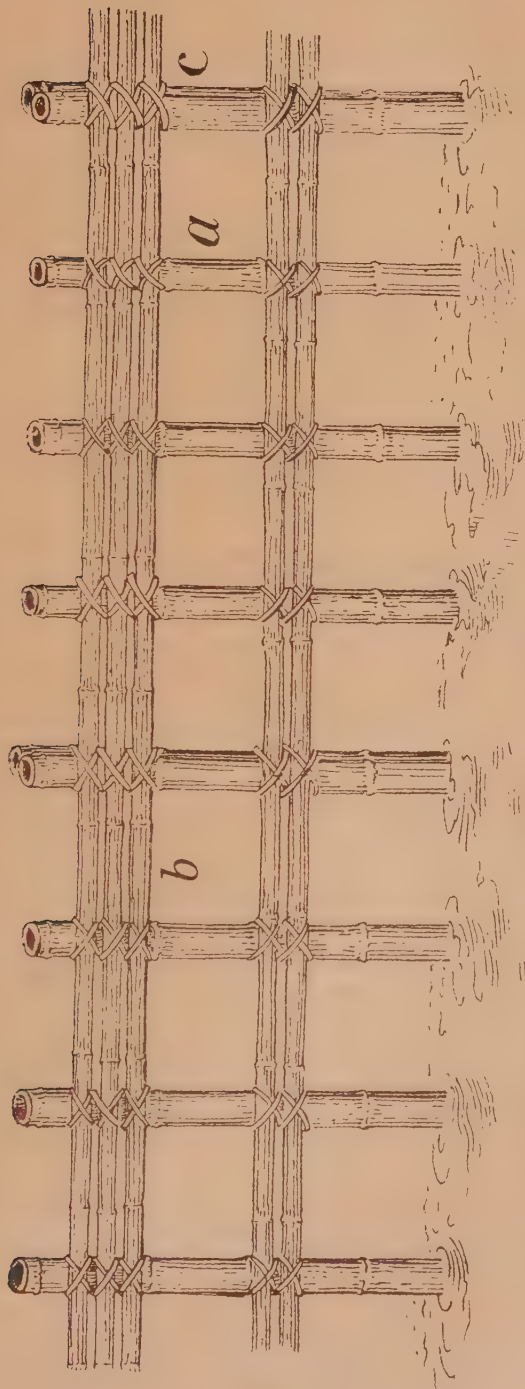


FIG. 3. The uprights or frames; *a*, uprights; *b*, braces; *c*, a bundle of two bamboos.

spp.). Figs. 4 and 5 show the appearance of the bamboo screens and Table 1 gives their specifications in the different parts of the fish corrals. As the depth of the bamboo screens are shallower than the depth of the water, two or more are joined end to end to fence the entire column of water. The screens for the leader, wings and forechamber have slats

TABLE 1.—*Specifications of the new hasang moderno operated at Kalibo, Capiz.*

Parts					Bamboo screens			Remarks
Name	Symbols	Length in meters	Number of posts	Number of screens	Size of screens in meters (depth x length)	Size of of splits in meters (width x (length)	Distance between splits in meters	
L	AB1	30	6	12	4.2×5	0.02×4.2	0.12	Excepting At two rows of bamboo screens are set on the framework overlapping each other by 10 cm.
E	AB2	35	7	14	4.0×5	0.02×4.0	0.12	
A	AB3	35	7	14	3.8×5	0.02×3.8	0.12	
D	AB4	35	7	14	3.5×5	0.02×3.5	0.12	
E	AB5	35	7	14	3.2×5	0.02×3.2	0.12	
P	AB6	35	7	14	3.2×5	0.02×3.0	0.12	
	AB7	35	7	14	3.0×5	0.02×3.0	0.12	
Total		240	28					
W	—DC	29	6	12	4.2×5	0.013×4.2	0.83	Two rows of bamboo screens are set on the framework overlapping each other by 10 cm.
	—DE	15	3	6	4.5×5	0.013×4.5	0.83	
I	YZ	29	6	12	4.2'5	0.013×4.2	0.83	
N	—XY	15	3	6	4.5×5	0.013×4.5	0.83	
	—JI	28.5	6	11.8	4.7×5	0.013×4.7	0.12	
G	—NU	14	3	6	5.4×5	0.012×5.4	0.42	
S	—UV	28.5	6	11.8	4.7+5	0.013×4.7	0.12	
	—TU	14	3	6	5.4×5	0.012×5.4	0.042	
Total		171	40	71.6				
Forechamber	DF	12.5	4	4	4.5×6.25	0.013×4.5	0.83	Two rows of bamboo screens are set on the framework overlapping each other by 10 cm.
	FG	30.25	10	10	4.9×6.15	0.013×4.9	0.83	
	YW	12.5	4	4	4.5×6.25	0.013×4.5	0.83	
	WG'	30.25	10	10	4.9×6.15	0.013×4.9	0.83	
Total		85.50	28	28				
Semicircular enclosure	IK	10	3	4	6×5	0.012×6	0.42	Two rows of bamboo screens are set on the framework overlapping each other by 10 cm.
	KL	36.47	12	14	6×5.3	0.012×6	0.42	
	LS	4	2	2	6×4	0.012×6	0.01	
	RQ	4	2	2	6×4	0.012×6	0.01	
	QU	46.47	15	18	6×5.3	0.021×6	0.42	
Total		98	34	440				

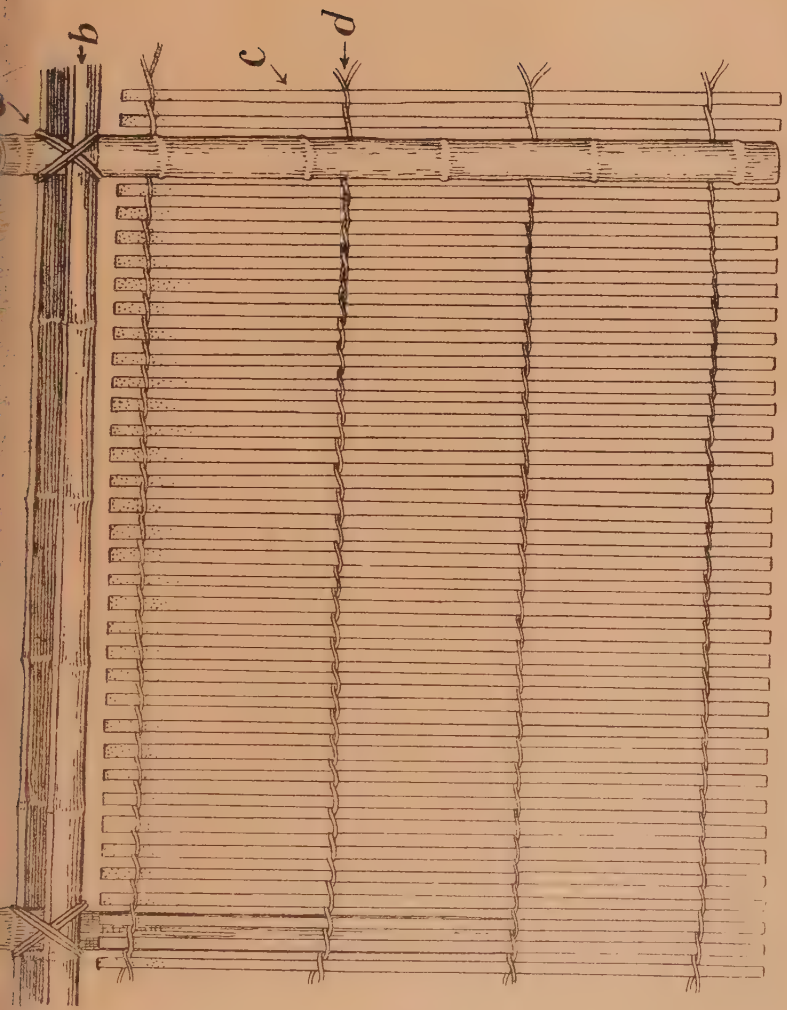


FIG. 4. A diagrammatic presentation of a portion of the terminal pound and semicircular enclosure showing the lacing of the slats; *a*, uprights; *b*, brace; *c*, bamboo screen; *d*, lacing.

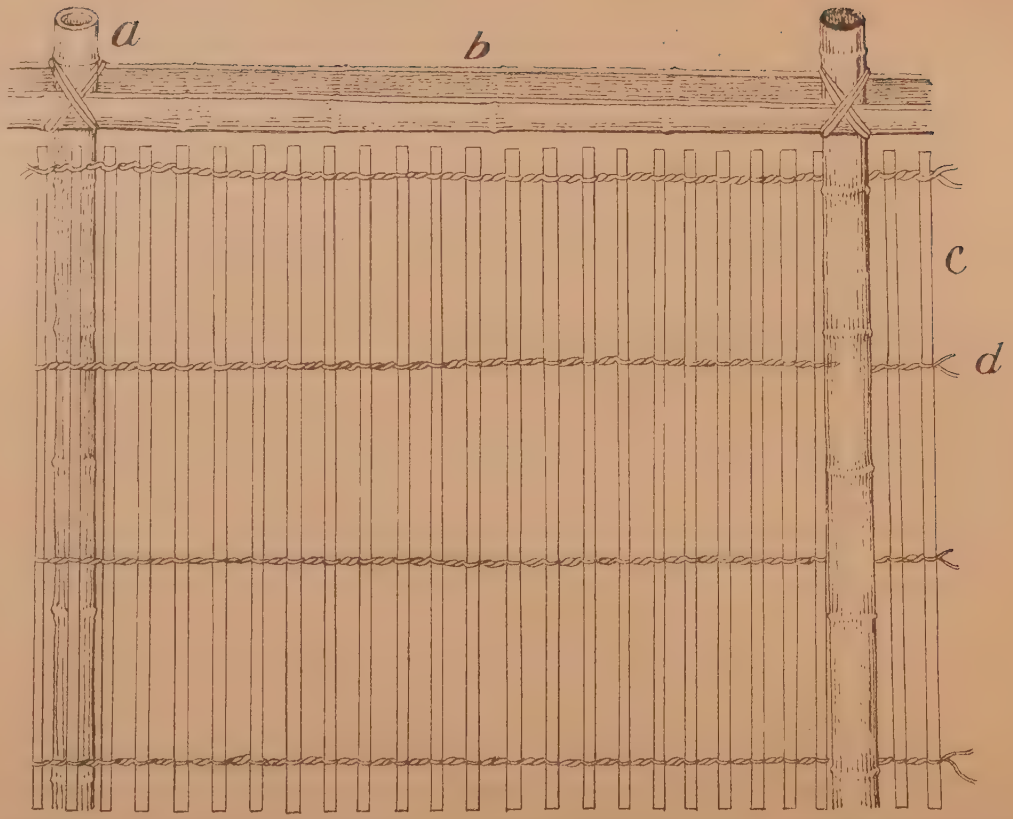


FIG. 5. A diagrammatic presentation of a portion of the bamboo mating used at the

Terminal pound	LM	2.8	2	3	6×2.5	0.012×6	0.01	Two rows of bamboo screens are set on the framework overlapping each other by 10 cm.
	MN	8.5	4	6	6×4.3	0.012×6	0.01	
	NO	3.5	2	3	6×3.7	0.012×6	0.01	
	OP	8.5	4	6	6×4.3	0.012×6	0.01	
	PQ	2.8	2	3	6×2.5	0.012×6	0.01	
Total		26.1	14	21				
Gates and entrances	—EB	6.5						A bamboo bridge is constructed above each gate and entrance.
	—BX	6.5						
	—NG	3.2						
	—GT	3.2						
	—GG'	4.25						
	—RS	0.5						

coarser than those for the semicircular enclosure and terminal pound.

The screens are grouped according to the parts of the fish corral where they are intended to be set. Those that go together are joined lengthwise, and then rolled like mats to facilitate the handling and placing along the framework of the fish corral.

The setting of the fish corral is done after the fishing ground has been carefully mapped out, and all materials for the frame and screens have been prepared.

CONSTRUCTION AND SETTING OF THE FISH CORRAL

The outline-plan of the fish corral (fig. 2) is carefully laid or plotted by using imaginary lines and temporary stakes. The leader is laid perpendicularly to the direction of the current or the shoreline. Its length depends upon the distance of the corral to the shore. Generally, the end of the leader reaches very near the shoreline. It is believed that the longer the leader, the more fishes are intercepted and guided into the collecting pound of the gear. This setting requires the services of the fish-corral-master fisherman, who directs several good divers and other hands. The planting of the posts is done during low tide. Guide posts are first planted: anterior and posterior ends of the leader and wings, then the ends and corners of the different chambers. The planting of the other posts follows by setting them at two meters apart at the semicircular enclosure and terminal pound; three meters interval at the forechamber; and 5 meters between them at the wings

and leader. Care is taken so as to make them stand perpendicularly to the water. To strengthen the hold of the corral at the bottom and to prevent the posts from reclining due to wind and wave action, a bundle of two to four bamboos (fig. 3*c*) is used for every fourth post. Two to four lines of bamboos are braced to connect each pole just above the bamboo screens. The whole set of the bamboo poles constitute the framework of the fish corral.

The setting of the bamboo screens follows the completion of the frame. As in the setting of the posts, a stone weight of about 15 kilos is tied at the lower end of every rolled screen to keep it standing erect close to the frames when sank. The screen is unrolled little by little and tied with the rattan splits, hagnaya, or threaded coconut inflorescence bud scales to the framework. This procedure is repeated until all the screens are set to the different parts of the fish corral.

The setting of the screens is usually begun with the terminal pound followed by the semicircular enclosure, then the upper wings, forechamber, lower wings, and lastly, the leader. This order is followed because, often times, fishes begin to enter the enclosures as soon as they are set.

Unless destroyed by gales or typhoons, the hasang moderno may last from six to ten months. Its upkeep, however, requires periodical changing of the screens whenever they become weak or when they need cleaning and drying. Hence, there must be a reserve of at least one-half of the total number of screens needed in the fish corral during the season. When the season is over, all the screens are removed, leaving the framework in the water to be used again during the next season. The screens are scrubbed, dried and the weak slats changed and stored for the next season.

THE NETS

There are two nets used to catch the fish that enter the fish corral. One of them is the scoop seine (*sigin*) used to collect fishes at the semicircular enclosure. The other, the shrimp net, is used at the terminal pound.

Fig. 6 is a diagrammatic structure of the scoop seine and Tables 2 and 3 give its specifications. It consists of a bunt (fig. 6*A*, *B*) flanked by two wings (fig. 6*C*, *D*) hung on a 27.13 meters head rope, 22.56 meters foot rope and 12.19 meters breastline. Each wing is made of 9-thread cotton twine net-

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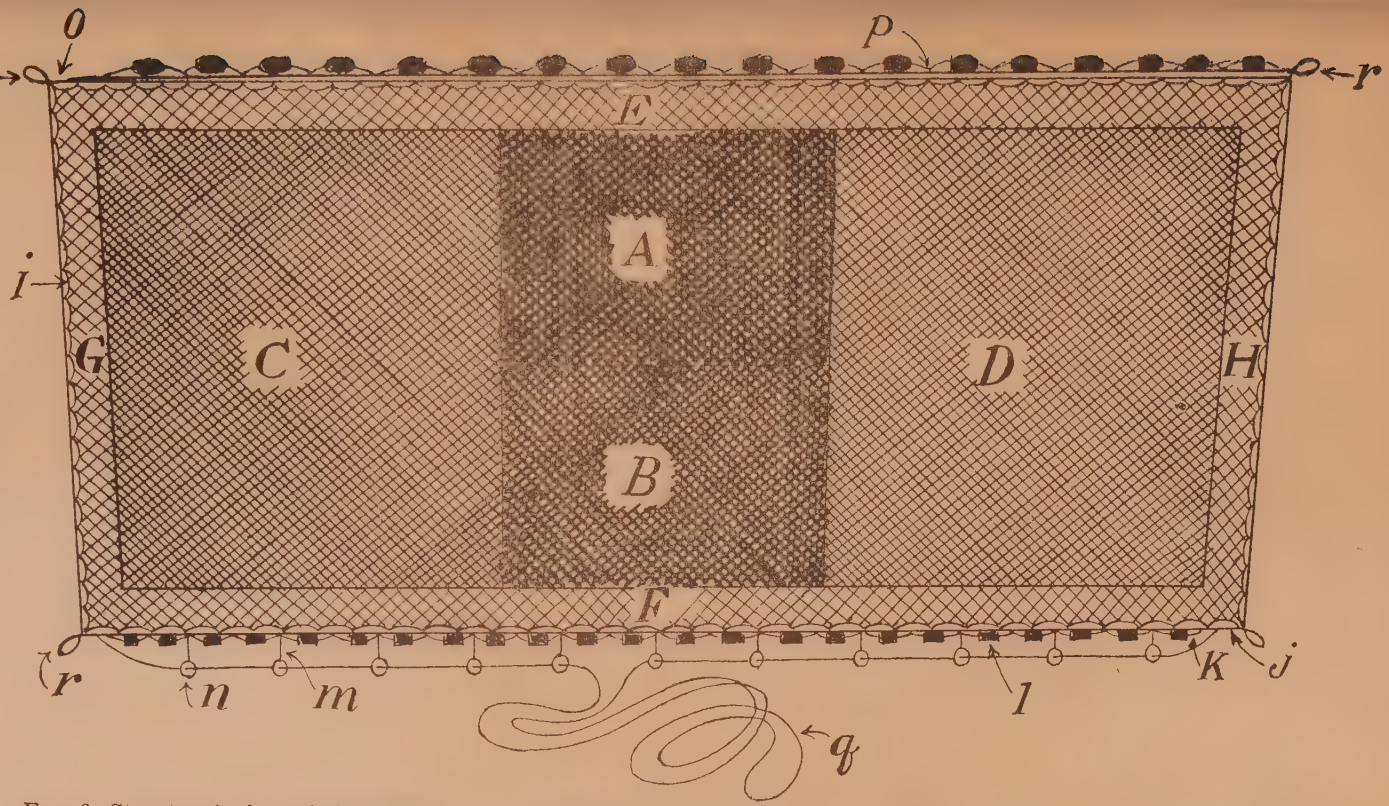

FIG. 6. Structural plan of the sigin: *A* and *B* bunt; *C* and *D*, wings; *E*, *F*, *G* and *H*, selvages; *i*, breast line; *j*, secondary lead line; *l*, lead weight; *k*, primary leadline; *m*, bridle; *n*, ring; *o*, secondary floatline; *p*, primary floatline; *q*, pursing rope; *r*, eye splice.

TABLE 2.—*Specification of the seine (sigin)*

Parts	Symbols	Materials: Kind	Materials: Twine number	Size of meshes stretched	Horizontal	Meshes deep	Strip	Remarks
Bunt	—A	cotton twine	12	2.24	312	500	1	Nettings joined mesh to mesh
	—B	cotton twine	9	2.54	300	300	1	
Wings	—C	cotton	9	2.54	573	800	1	Nettings joined mesh to mesh
	—D	cotton	9	2.54	573	800	1	
S	E	cotton	36	5.72	7	486	1	Outer edges of bunt and wings are joined to the selvages 4 meshes of the former to every mesh of the latter and then laced by a 26-thread cotton twine to the hanging line.
E	F	cotton	36	5.72	7	407	1	
L	G	cotton	36	5.72	7	220	1	
V	H	cotton	36	5.72	7	220	1	
A								
G								
E								

TABLE 3.—*Ropes and other accessories of the seine.*

Parts	Materials	Size in cm.	Length in m.	Number of pieces	Remarks
Primary float line	Manila rope	0.91 dia.	27.13	1	Where 70 floats are tied at 30.48 cm. distances.
Secondary float line	Manila rope	1.58 dia.	27.13	1	Where the lacing line of selvage are hung.
Breastline	Manila rope	1.58 dia.	12.19		Where the lacing line on width is hung.
Primary leadline	Manila rope	0.91 dia.	22.56	1	Where the lacing line of the cotton selvage is hung.
Secondary leadline	Manila rope	1.58 dia.	22.56	1	Where the lead weights are tied at 35.56 cm. distances.
Pursing rope	Manila rope	1.27 dia.	50	1	Each end is tied to the end of the primary leadline.
Briddle line	Manila rope	0.91 dia.	0.46	62	Distributed along primary leadline 45.72 cm. apart.
Floats	Soft wood	4 dia.	7.62	70	Equally distributed along the primary cork-line, 30.48 cm. far apart.
Sinkers	Lead	4 ounces		62	Equally distributed along the primary leadline 35.56 cm. far apart.
Rings	GI	.6×7 dia.		18	

ting of 2.54 centimeters mesh-stretched, 573 meshes wide and 800 meshes deep. The bunt is composed of two nettings, the upper portion of which is 312 meshes wide and 500 meshes deep, 2.24 centimeters mesh-stretched and made of 12-thread cotton twine; while the lower portion is a 9-thread cotton twine netting, 2.54 centimeters mesh-stretched, 312 meshes wide and 300 meshes deep. These are joined together mesh to mesh.

FIG. 7. A portion of the headline; *a*, eye, splice; *b*, float; c, primary floatline; *d*, secondary floatline; *e*, lacing line; *f*, breastline.

The selvages (fig. 6*E, F, G, H*) of coarser nettings are made of 36-thread seine twine, being 5.72 mesh-stretched and joined with the wings and bunt with a ratio of one to every four meshes. The selvages are seized by a 9-thread twine and hung to the secondary corkline, breastline and secondary leadline. Each end of the hanging line is an eye-splice (fig. 6*r*) of 7.62 centimeters diameter. A pull rope is tied to each of these eye-splices during the fishing operation. The ends of the purse line (fig. 6*g*) are spliced on the ends of the secondary leadline.

Fig. 7 shows a portion of the corkline. Each float is 7.62 centimeters long and 4 centimeters at its greatest diameter. The floats are tied along the primary floatline (fig. 7*c*) at 30.48 centimeters intervals. Sixty-two lead weights (fig. 6*l*), each weighing four ounces are strung to the leadline at intervals of 35.56 centimeters. In operation, two additional stone weights of 40 pounds each are tied to each end of the leadline to facilitate the sinking of the net.

The primary corkline and the primary leadline are spliced to the secondary corkline and secondary leadline, respectively.

Fig. 8 is the diagrammatic presentation of the shrimp net. It is in the form of an isosceles trapezoid and made of several pieces of sinamay cloth sewed together. This is hung to a Manila rope, 1.27 centimeters in diameter, with 40 per cent slack by a 9-thread cotton twine. The finished shrimp net is 7.74 meters and 3.43 meters on its parallel sides, while each of the nonparallel sides is 8.43 meters.

Like the scoop seine, each end of the hanging line is an eye splice (fig. 8*b*) where the pull rope is tied during the operation. On the midpoints of each of the nonparallel sides and ends of the longer parallel side are tied GI rings (fig. 8*c*) which are threaded into the gliding rope when the net is shot and hauled in at the terminal pound.

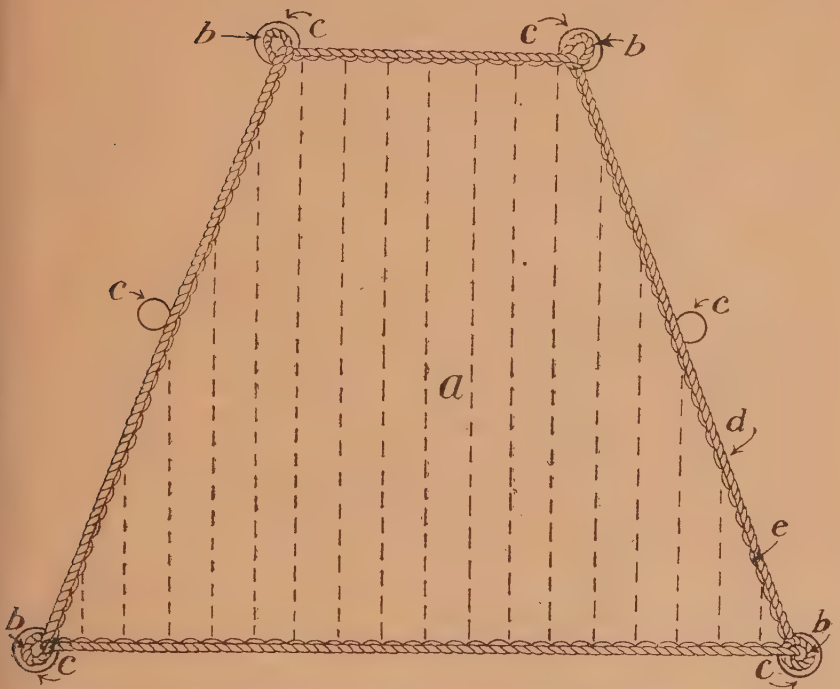

FIG. 8. A diagrammatic presentation of the structural plan of the shrimp net (not drawn to scale): *a*, sinamay cloth; *b*, sling; *c*, G. I. rings; *d*, hanging line; *e*, lacing line.

The following materials enter into the construction of the shrimp net: 87.47 meters × 1 meter sinamay cloth, 30 meters Manila rope × 1.27 centimeters diameter, 4 pieces GI rings 0.8 cm. × 7.62 cm. diameter, and 50 meters cotton twine 9-thread medium laid.

THE BOATS

Two boats are used in the fishing operation. The bigger boat (fig. 9) is used to transport the fishermen and nets to and from the fish corral, while the smaller one is used to carry the catch from the fish corral to the shore. The bigger boat is an ordinary dugout, 14 meters long, 1 meter wide and 0.54 meter deep, with one wooden planking on each side. An outrigger is provided only on the port side of the dugout, so that it can be brought close to the fence of the fish corral.

FIG. 9. Top view of the main boat; *a*, hallow keel; *b*, bow; *d*, wodden planking; *e*, bamboo for oar-locks; *f*, outrigger.

The small boat (fig. 10) is flat-bottomed with pointed bow and no outriggers. It is about 3.84 meters long, 0.7 meter wide and 0.49 meter deep. A piece of bamboo is tied on top of each gunwales (fig. 10*a*) where the oars are tied when the boat is rowed. Like the bigger boat, the depth and deck space are increased by planking on each side.

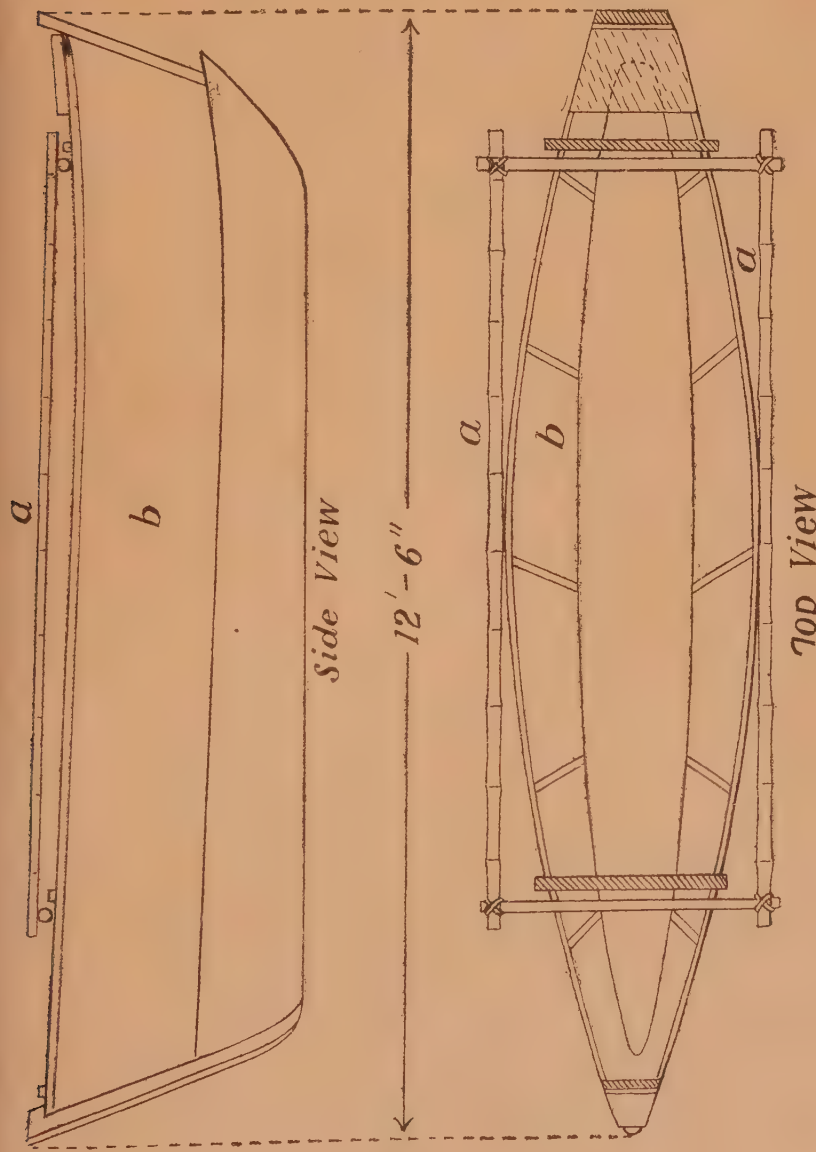

FIG. 10. The lateral and side views of the small boat; *a*, bamboo oarlocks; *b*, planking.

THE CREW: THEIR DUTIES AND PARTICIPATION IN THE CATCH

A complement of 16 fishermen is needed to operate the fish corral: one master fisherman, two assistant master fishermen, four divers and nine ordinary fishermen. The master fisherman directs all the work, including the construction, maintenance and fishing operations of the fish corrals, and the marketing of the catch. The divers do the construction and repair of the gear, while the ordinary fishermen act as general utility men. All, however, help in the catching of the fish inside the semicircular enclosure and the terminal pound.

The splitting of the bamboos, cleaning and lacing or weaving of the slats of the bamboo screens are done by contract labor. The expenses incurred are considered as a part of the costs of operation which are deducted from the gross sales before the profit is declared.

The members of the crew are paid on the profit-sharing basis. The cost of operation, which includes the expenses incurred for the construction of the bamboo screens, taxes, licenses, twines, rattan splits and other supplies needed in the repair of the fish corral and accessories, is deducted from the gross sales and the remainder is divided into two equal parts. One part goes to the owner of the fish corral while the other part is divided into 19 shares distributed as follows:

1 Master fisherman	2	shares
2 Assistant master fisherman	1½	shares each
4. Divers	1¼	shares each
9 Ordinary fishermen	1	share each

FISHING OPERATION

The catching of the fish that enter the terminal pound and the semicircular enclosure is done during the early dawn so that the catch may be brought to the market in time to be sold in the morning. Hauling may also be done at night during the dark phase of the moon, especially during ebb time, to catch shrimps and other fishes with the use of light.

Seven men consisting of one assistant master fisherman and six ordinary fishermen are needed to operate the shrimp net in the terminal pound. Four stone weights of two kilos each are tied to the four corners of the net. Then gliding ropes are tied at points *e* and *f* of sides AC and BD (fig. 11) respectively, and perpendicularly down to the base of the frame. To this,

each ring (fig. 8*c*) is threaded by the corresponding gliding rope thus allowing the net to glide up and down when setting and hauling. They also serve as supports of the net when set, and keeping it from being drifted by the current.

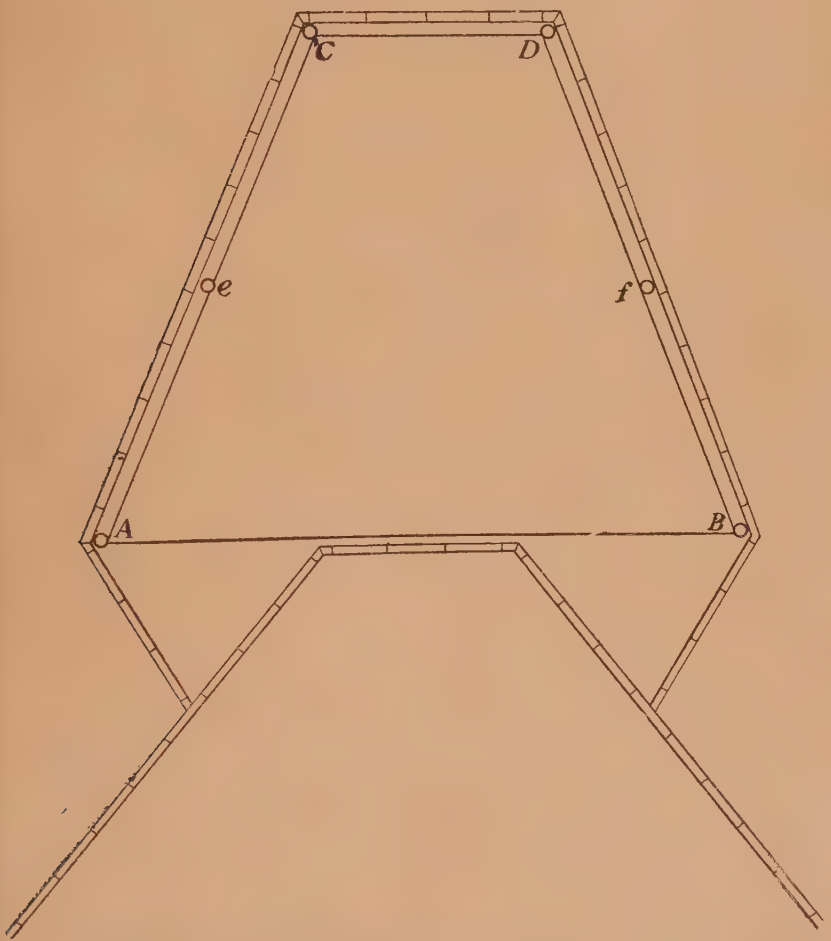

FIG. 11. The terminal pound showing how the shrimp net is laid out during fishing operation. *A B C D* the net.

In setting the net, the eye splices (fig. 8*b*) are each tied down with a pull rope while the rings are threaded by the respective gliding ropes. The corners are tied with a stone weight of two kilos each. Corners C and D (fig. 11) are brought near points *e* and *f* and dropped to the bottom. The other portion of the net (fig. 11:AB*fe*) is also dropped. This

is done to prevent the covering of the fish inside the pound by the net. Then, the pull ropes at C and D are pulled to spread the net in such a way that the bottom of the terminal pound is covered entirely. After a while, it is raised to scoop the catch. This operation is performed several times.

Fig. 12 is a diagrammatic presentation of the setting and hauling of the net at the semicircular enclosure. Nine fishermen, including the master fisherman and one assistant master

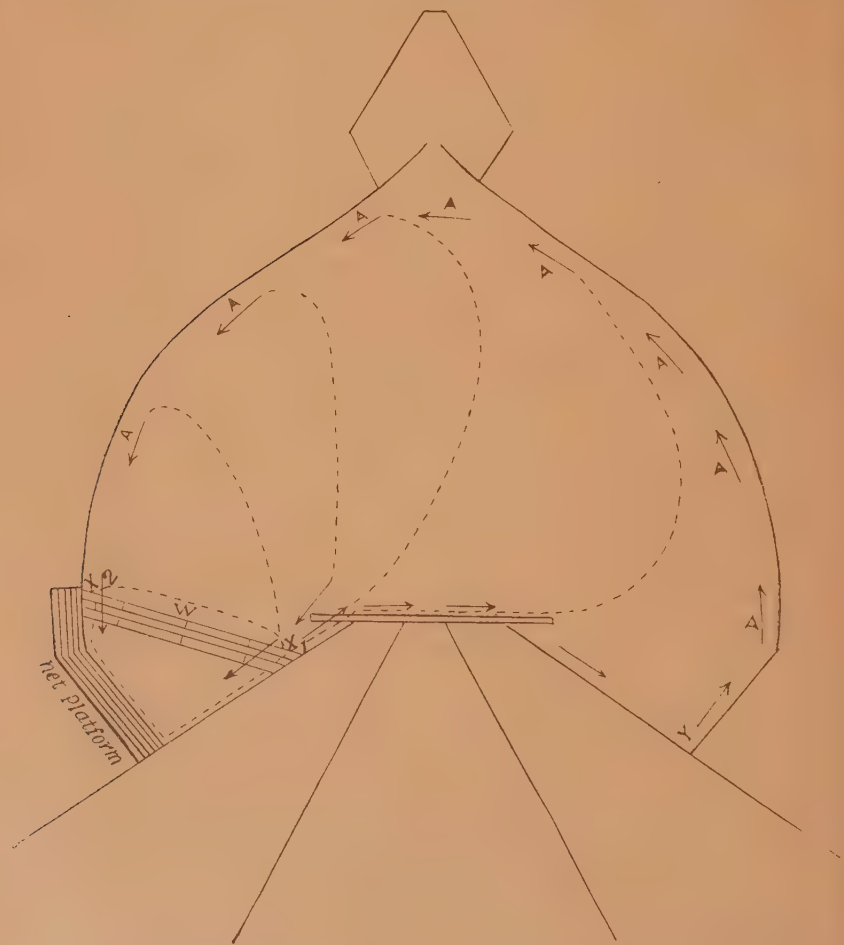

Fig. 12. A schematic drawing showing the catching of fish at the semicircular enclosure.

fisherman, are needed to operate the scoop seine. The net is dropped at the bamboo bridge (fig. 12*W*) at X_1 and then extended to Y thus transforming it into a curtain closing the

entrance and gates of the fish corral. The end, at Y, is dragged close to the fence following the direction as indicated by arrow A of fig. 12 until X_2 is reached. This movement is followed by four divers who see to it that the leadline touches the seabed and the fence of the enclosure. Three men on the bamboo bridge hold the floatline while the leadline is brought close to the fence below the net platform and the bottom of the net is raised by pulling the pursed line, thus forming a sort of hammock. Here, the fishes are concentrated at the bunt where they are scooped and placed on the waiting banca. This operation is repeated several times.

THE CATCH

Table 4 is a list of the common fishes caught in the hasang moderno. Most of them are pelagic species which are found on a commercial scale during the season. Shrimps are also caught during the dark phase of the moon specially so when a lamp is used to attract them at the terminal pound.

The catches are sold either to fresh fish vendors, who go to the fish corral during hauling, or to wholesale buyers who are owners of salting plants. Direct icing of the catches is not practiced.

TABLE 4.—*Fishes caught by hasang moderno.*

English name	Local name	Scientice name
Anchovies	Bolinao	*Stelephorus* spp.
Bañgos	Bañgus	*Chanos chanos.*
Barracuda	Batog	*Sphyraena* spp.
Big-eyed scad	Bocawan nga buca	*Selar crumenophthalmus.*
Cavalla	Ampalian	*Caranx* spp.
Do.	Maming	Do.
Do.	Balilin	Do.
Do.	Momsa	*Caranx sexfasciatus.*
Devil fish	Sunga	*Mobula* spp.
Drepane	Bayang	*Drepane punctata.*
Grouper	Lapu-lapu	*Epinephelus* spp.
Guitar fish	Sodsod	*Rhynchobatus djiddensis.*
Hair tail	Liwit	*Trichiurus haumela.*
Leather jackets	Salindato	*Scomberoides* spp.
Mackerel	Bulao	*Rastrelliger chrysozonus.*
Do.	Aguma-a	*Rastrelliger brachysomus.*
Moon fish	Habas	*Mene maculata.*
Pampano	Mariano	*Caranx* spp.
Shark	Pating	Galeidæ.
Skipjacks	Tulingan	*Katsuwonus pelamis.*

English name	*Local name*	*Scientivc name*
Spanish mackerel	Tangigue	*Scomberomorfis commersoni.*
Swordfish	Malasugi	*Xiphias gladius.*
Yaito tuna	Bantala-an	*Euthynnus* spp.
Yellow tuna	Tulingan	*Neothunnus macropterus.*

MISCELLANEOUS

Squid	No-os	*Loligo* spp.
Porpoises	Lumba-lumba	
Shrimps	Alamang	Atyidæ.

CAPITALIZATION AND CATCH OF A NEW "HASANG MODERNO" OPERATED AT KALIBO, CAPIZ, IN THE SUMMER MONTHS OF 1950

A. *Capitalization:*

1. *Equipment—*

One banca, 14 m. × 1 m. × 0.54 complete with outrigger on one side	₱250.00	
One banca, 3.84 m. × 0.7 m. × 0.49 m., flat bottom	50.00	
One ring net (sigin), 25.82 m. head rope × 12.19 m. breast line × 22.55 m. ground rope, complete with floats weights and pursing devices	1,405.00	
One shrimp net (sinamay), 7.75 m. × 3.43 m. × 8.43 m., complete with rings and pull ropes	50.00	
One scoop net with handle	5.00	
Eight pieces of oars	20.00	
Total for equipment		₱1,780.00

2. *Supplies—*

1,187 pcs. bamboos without spines, each at least 10 m. long	₱842.00	
350 pcs. bamboos, with spines at least 10 meters long	350.00	
2,050 pcs. split rattan	58.00	
15,000 pcs. coconut inflorescence bud scale sheaths	195.00	
1 roll Manila rope, ½" diameter	67.00	
Total for supplies		1,512.00
Grand Total		₱3,292.00

B. *Cost of operation:*

1. Licenses—for a year lease of the fishing ground	₱750.00
2. Taxes—	
Privilege tax	10.00
Sales tax—5 per cent of gross sale	503.75
3. Supplies—rattan, bamboos, twines, nettings, etc., needed for repairs	300.00
4. Labor—	
For splitting bamboos including cleaning of splits	45.00
5. For lacing bamboo splits into bamboo screens	350.00
6. For setting the fish corral	51.25
Total cost of operation	₱2,010.00

C. *Sales:* Total sales from April 1, 1950 to October 15, 1950 .... ₱10,074.62

Months	Fish caught	Sales
April	2,649.00	₱2,560.20
May	5,170.75	3,146.32
June	5,107.00	1,350.26
July	1,747.50	769.31
August	560.80	537.70
September	1,033.00	815.36
October (1-15)	960.00	895.47
Total	17,288.05	₱10,074.62

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ILLUSTRATIONS

TEXT FIGURES

FIG. 1. Hasang moderno (1932) diagrammatic: *g*, entrance; *l*, leader; *m*, gate; *w*, wing; *el*, elbow; *fc*, forechamber; *se*, side gate; *si*, semicircular compartment; *tp*, terminal pound.

2. The new hasang moderno: *AB*, leader; *CE*, and *XZ*, lower wings; *JH* and *TV*, upper wings; *EX*, *GH*, *G'T*, gates; *DFGG'WY*, forechamber; *IKSRK'UT*, semicircular enclosure; *LMNOOPQ*, terminal pound.

3. The uprights or frames: *a*, uprights; *b*, braces; *c*, a bundle of two bamboos.

4. A diagrammatic presentation of a portion of the terminal pound and simicircular enclosure showing the lacing of the slats: *a*, uprights; *b*, brace; *c*, bamboo screen; *d*, lacing.

5. A diagrammatic presentation of a portion of the bamboo mating used at the wings, forechamber and leader showing how the slats are laced: *a*, bamboo post; *b*, brace; *c*, bamboo screen; *d*, lacing.

6. Structural plan of the sigin: *A* and *B*, bunt; *C* and *D*, wings; *E*, *F*, *G* and *H*, selvages; *i*, breastline; *j*, secondary leadline; *l*, lead weight; *k*, primary leadline; *m*, bridle; *n*, ring; *o*, secondary floatline; *p*, primary floatline; *q*, pursing rope; *r*, eye splice.

7. A portion of the headline: *a*, eye splice; *b*, float; *c*, primary floatline; *d*, secondary floatline; *e*, lacing line; *f*, breastline.

8. A diagrammatic presentation of the structural plan of the shrimp net (not drawn to scale): *a*, sinamay cloth; *b*, sling; *c*, G.I. ring; *d*, hanging line; *e*, lacing line.

9. Top view of the main boat; *a*, hallow keel; *b*, bow; *d*, wooden planking; *c*, stern; *e*, bamboo for oar-locks; *f*, outrigger.

10. The lateral and side views of the small boat: *a*, bamboo oarlocks; *b*, planking.

11. The terminal pound showing how the shrimp net is laid out during fishing operation. ABCD the net.

12. A schematic drawing showing the catching of fish at the semicircular enclosure.

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